THE BULLETIN

a monthly publication of the
AMERICAN CERAMIC SOCIETY
devoted to the promotion of ceramic art and technological education

■ Laboratory apparatus constructed by glass blowers of the Middle Ages was made free hand direct from the glassmelting pot. The first lamp-worked apparatus was fabricated on oil lamps burning "tree-oil" as fuel. This illustration shows a glass apparatus maker of 1780 constructing a piece of laboratory equipment. For an illustration of modern American lampworkers please see page 313.

Volume 13 NOVEMBER, 1934 Number 11

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Editorial and Advertising Offices: 2525 N. High St., Columbus, Ohio.
Executive Office: 2525 N. High St., Columbus, Ohio.
Committee on Publications: L. NAVIAS, *Chairman;* L. J. TROSTEL, M. F. BEECHER, R. M. KING, ROSS C. PURDY

Entered as second-class matter at the post office at Easton, Pa., under the Act of March 3, 1879
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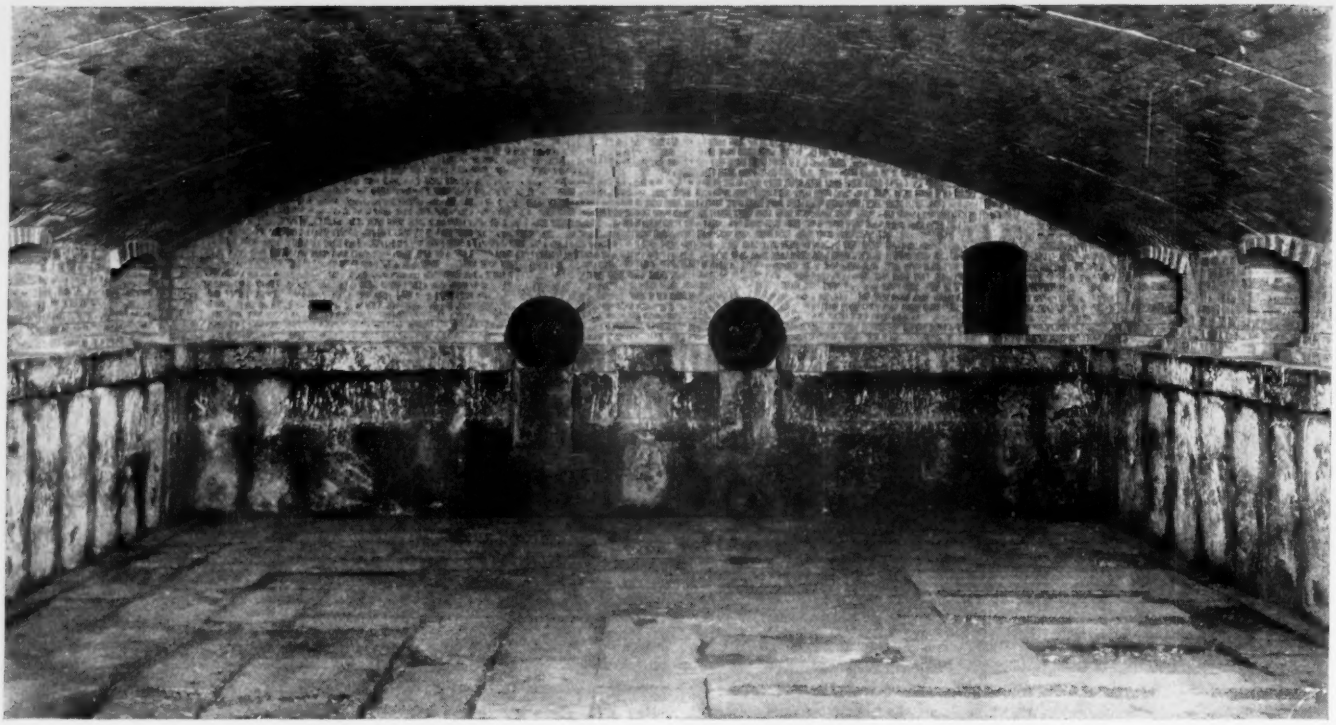

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A Monthly Publication Devoted to Proceedings
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of Technical, Scientific, and Art Questions

Vol. 13 November, 1934 No. 11

EDITORIAL

DESIGN IMPELS CONSUMER RESPONSE*

By Joseph Sinel[1]

America must awake to its full responsibilities in the arts and especially those that should determine the shapes of the things we use. Of course, it is much easier to make that statement than it is to supply the necessary talent, trained and disciplined in the requirements of industry.

We have the talent (perhaps no country is more favored in that regard), but that talent is untrained. The manufacturer has been ignorant or impatient, or he has merely preferred to pirate other design forms. The artist has been either ignorant of the immense scope of applied art or has looked upon it with scorn.

Of all our industries, ceramics is the one that has for the longest time been cognizant of the value of design. Unfortunately, most of the ceramic design, regardless of merit, has been flagrantly lifted from European sources. That this should ever have occurred is bad enough, but that it should persist today is unpardonable. It is detrimental to the ceramic industry to plagiarize European design chiefly because life on this continent differs greatly from life in other countries, calling not only for different objects, but also for expressions of design in those objects different from their counterparts in other lands.

In one branch of ceramics we have a veritable museum of inspirational influence: American Indian pottery in form, pattern, and color might well serve to direct us into new and vital channels of design. The peoples of other countries have appreciated this while we have apparently been too close to it to comprehend its merits.

It behooves the ceramic manufacturers to realize the tremendous potentialities and profits to their industry to be gained by the application of fundamental design to their products. Devising hasty expedients, short cuts, trick shapes, and stylistic decoration are no substitute for basic design principles.

The problem must be approached rationally with a view to the future advertising and marketing of the product. It must be done on a basis of coöperation between manufacturing, designing, marketing, and advertising divisions.

Isolated units of design should be avoided and a sound coördination of elements achieved. Stylized motifs date themselves too severely and become a dead weight with the passage of time. Fundamental design units that have character, smartness, class, will carry over a long period of years and achieve heightened consciousness of qualities and values.

Instead of being forced to follow a muddling process over the approaching years, the wise manufacturer may find a solution of his design problem in 1934 that will enable him to build consistently, to adhere to a profitable continuity in his advertising and sales programs.

Amazing techniques have been developed, but they are throttled by cumbersome and expensive methods of decadent and impoverished design.

The greater part of our ceramic product has suffered from over-elaborated form weighted down with ornate and meaningless decoration. It is a wise principle to use simple basic forms on which to place decoration. Design depends on emphasis for effect. The form and decoration can not be of identical character and succeed.

Perhaps no objects in daily use are so ugly as

* Presented at Annual Meeting, American Ceramic Society, Cincinnati, Ohio, February, 1934 (Art Division). Received May 31, 1934.

[1] Director of Industrial Design, Basic Marketing Associates.

the average run of tableware. Certainly none of our products are more sloppy in design elements. It should be possible to raise the standard at least to that of the average textile design. Tableware is one of the lines of merchandise that lags frightfully because of a pigheaded attitude in the trade in favor of the present type of senile design. Art directors, buyers, and salesmen stand as authorities and tell us what women want in tableware design. Some of us have heard the women's answer to that authority.

Vital design would compel a radical shift of consumer interest. Courage on the part of manufacturers to use vital design would meet with such ready response from women who are waiting for simple forms effectively decorated that the expansion in sales would be unprecedented.

Restaurant and hotel tableware is even worse than that which we find in the home. There is a tremendously rich and profitable field to exploit here. One smart move could create obsolescence of all the existing material of this nature. And this can be done without fundamental change in production methods. But it can not be done without the understanding approach of a capable creative and administrative group with an appreciation of the forms that meet with universal response and that interest women particularly.

The well-designed article conveys the impression of being the adequate object to use, besides having beauty of form and pattern. The vital considerations in the designing of tableware are (1) requirements of manufacturing processes, (2) fitness of the article for its proposed use, (3) the influence it exercises as an interesting object in the house, (4) all decoration must be subservient to form, and (5) form is dependent on function.

Suddenly there is a call for artists in industry. How is this demand to be supplied? It would seem that any one styling himself an industrial artist, provided he is cheap enough, can get a job. Already industrialists are combing the country for men and women who can make shapes for their ware. The call is being answered by any one who has a mind to make a living that way, irrespective of qualifications. It is unbelievable that manufacturers would fall such easy prey to this new racket, for racket it is and will continue to be until we arrive at some rationalized status for design in industry.

Advertising agencies failing to get their accustomed results from past methods tell the manufacturer his product is at fault, that he must dress it up, reshape it, and paint it up to pass muster. They are usually afraid to tell the manufacturer when his product is structurally poor or obsolete for modern use, but feel perfectly free to introduce the new panacea of industrial design. So we have the magazines and trade journals agitating for the "face-lifting and beautifying processes." But we can not have suitable design in our products as easily as that—suitable design for the technical limitations as well as for consumer response and requirement. Consequently, we are about to see many terrible things perpetrated in the name of industrial art, and American industry as a whole is about to pay a serious price for its blunders in that direction. The cost of tools and dies and molds is too great to risk on any fanciful shapes contrived by just any one who wishes to call himself an industrial designer. Manufacturers and manufacturers' representatives must take this warning seriously and consider carefully the qualifications of a designer before they let him meddle with their products.

Let us not delude ourselves; design is a manufacturing adjunct and as such must eventually be practised in the factories by artists thoroughly acquainted with the processes and materials. Ultimately, a few, a very few men and women of unusual qualifications and experience in a free-lance advisory capacity will be of great help in assisting and directing the efforts of the artists actually working in the factories.

There are schools of engineering and technology throughout the country, but there is not one single institution that is equipped to give adequate training in significant form as applied to the products of industry. There is at present no real course in industrial art; and I do not consider the art school the place to train industrial artists. But there should be a collaboration between the art schools and the technological institutes for then the student could have access to more than paper, pen, and brush. If these institutions are alive to the new importance of the artist in industry, they will put the subject of industrial design on their curricula.

The artist is necessary in industry because he, more than any one else, comprehends the human hunger for beauty in life and has the faculty to to create that beauty

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PAPERS

THE HISTORY OF GLAZE AND ITS PLACE IN THE CERAMIC TECHNIQUE OF ANCIENT SELEUCIA ON THE TIGRIS*

By Neilson C. Debevoise

I. Introduction

The past quarter of a century has witnessed an advance in ancient history which is paralleled only by a few of the other social sciences. The spade of the archeologist has revealed entire civilizations which a decade ago were scarcely more than myths and has disclosed much detailed information on the lives of these peoples. Because of certain special qualities, the archeologist has come to rely heavily upon ceramic evidence in his search for interrelations and new developments. In the Orient and especially in those countries which, like Mesopotamia, lack stone and metal, the art of the potter was developed until it touched every phase of man's activity. Man ate from clay vessels, he lived in clay houses, he wrote on clay tablets, and finally he was buried in a clay coffin, furnished with clay images of his servants in the next world.

In the absence of written evidence or dated coins, the products of the potter's wheel provide us with one of the best chronological scales. Owing to the very nature of the material, pottery seldom remains intact over a period of years; sooner or later, cracked or broken, the discarded pot finds its way to the dump heap. Clay is a material which can carry on a tradition or discard it with equal ease, since it expresses the transient feelings and thoughts of the potter. Unfortunately, pottery seldom bears a date and we must depend on associated material or catalogues prepared from some previously excavated site to assign it to the proper period.

One of the problems which confronted early man in countries where stone and metal were scarce was the lack of suitable containers for liquids such as beer, wine, or oil. Water was kept in porous jars to take advantage of the natural refrigeration which rapid evaporation afforded. Early attempts to provide impervious vessels by polishing pottery with a pebble or bone, burnishing it as we say, were made in many places, and in Mesopotamia pots were coated with bitumen. In fact, large storage jars were thus waterproofed even as late as the Christian era, especially in Iraq, where bitumen was plentiful. The development of glaze, which we shall define as a vitrified siliceous paste, eventually brought about a satisfactory solution to the problem and one which we still continue to employ. When and where did this development take place?

II. History of Glaze

For the sake of clarity let us discuss the history of glaze on a geographical basis and begin with Crete and the islands of the Ægean. Glazed paste objects and vessels appear to have been introduced to this region from Egypt and the technical advances which followed the first appearance of indigenous products in the Early Minoan II period[1] in the third millennium B.C. continued for some time. Possibly because of the availability of stone, metals, and glass, and a preference for these materials, pottery with glaze was never popular in Greece or Italy.[2] The extremely decorative red and black Greek "varnish" ware and the Roman terra sigillata effectively took the place of glazed ware which in the Orient was indispensable.

In Egypt, the development of glaze and glazing technique proceeded along different lines from those in the remainder of the Near East or the Iranian plateau, but apparently similar to those of India. In the Land of the Nile, the base for glaze was never pottery but rather a finely ground silica, either sand or pulverized rock. Occasionally sandstone itself appears to have been used.[3] Possibly some adhesive was employed to hold the fine silica together, but the real strength of the object was obtained by the glaze which soaked

* Presented at Annual Meeting, American Ceramic Society, Cincinnati, Ohio, February, 1934 (Art Division). Received February 5, 1934.

[1] Arthur Evans, The Palace of Minos, Vol. 1, pp. 85 and 486–93. For somewhat later material, see H. R. Hall, "Minoan Faience in Mesopotamia," *Jour. Hellenic Studies*, **48**, 64–74 (1928).

[2] For an introductory bibliography to this field, see G. M. A. Richter, "Roman Glazed Pottery," *Bull. Met. Mus. Art*, **19**, 94–95 (1924).

[3] A. Neuburger, The Technical Arts and Sciences of the Ancients, translated by H. L. Brose, pp. 137–38. A glazed sandstone plaque of Terneter (*cir.* 3400–3200 B.C.) is now on exhibition at the Oriental Institute, University of Chicago.

into the paste when fired. The core, which usually remained porous and friable, was bound into a solid piece by the skin of glaze which covered it.[4] Much glazing was done over quartz, schist, and later steatite. Glazed objects made of this paste in the form of flowers were sewn to dresses for decoration just as the modern Arab uses tiny rondels of the same material. The capitals of the columns were inlaid with brilliant-colored designs often utilizing the palm leaf or the lotus motif. When it became customary to place with the dead small figurines to serve the deceased in the next world, the manufacture of these figures gave employment to many, for they were used by the thousand. About four hundred were sometimes entombed with a wealthy individual and qualities were to be had to suit every pocketbook.

While glazed objects appear as early as the fifth millennium B.C.[4a] in Egypt, it is not until the fourth millennium B.C. that beads of paste[5] have been found in predynastic Egyptian graves. The use of blue glaze became common on vessels made of paste about the time of Amenhotep III (1411–1375 B.C.), but it was not until Roman times that pottery vessels were glazed. An alkaline silicate of lime could not be placed directly over the earthenware for the Egyptian glaze was never correctly adjusted for differences in expansion. Not until very late was this overcome by interposing a slip of high silicate content over the pottery as a base for the glaze.[6]

The technique of glazing over a paste body passed northward to the islands of the Ægean and the mainland of Greece and perhaps to Mesopotamia, for it appears among the very early material from Jemdet Nasr and Kish.[7] In India the use of paste over glaze was highly developed about the middle of the third millennium B.C.

We may safely say that by 3400 B.C. Egyptian ceramic workers were able to utilize glaze with a facility which proves a long acquaintanceship. Two-color work could be produced without streaking and tile about a foot long were colored with an excellent hard blue-green glaze.[8] Knowledge of glazes soon developed to a point where a wide range of color was available and a complicated technique for handling materials had been devised. Lead glaze does not appear. Copper, tin, iron, manganese, and cobalt were used as coloring oxides.

NOTE: At present the terminology in use by archeologists and historians of ceramics is so badly confused as to be incomprehensible. Neilson C. Debevoise (Parthian Pottery from Seleucia on the Tigris, *Univ. Michigan Studies, Humanistic Ser.*, Vol. 32, p. 40) gives some simple definitions largely based on those drawn up by Mesopotamian archeologists (*Syria*, **11**, 307–308 (1930)); an excellent and much more detailed study is Benjamin March, Standards of Pottery Description, *Occasional Contributions from Museum of Anthropology, Univ. Michigan*, No. 3, Ann Arbor, 1934.

Faience has so long been employed by Egyptologists that it has become intimately associated with objects made of a paste body and covered with a green or blue-green glaze. Perhaps it is best to retain the word, but in this sense only, and the term should not be used for a glaze applied over a pottery body.[9] Glaze is best defined as a vitrified siliceous paste. This excludes the so-called black and red varnish ware of Greece and techniques like the Roman Samian or terra sigillata and Arretine pottery for which some special terms must be devised.

In India glaze appears at an early date and its development there parallels very closely the development of Egyptian glaze. Our best source of information is the mound known as Mohenjo-Daro on the Upper Indus River which was excavated by Sir John Marshall who recently published his results in three splendid volumes. From the contemporary finds of similar material at Tell Asmar, Iraq, by Dr. H. Frankfort of the Oriental Institute, the Mohenjo-Daro discoveries may be dated to about 2500 B.C.[10]

The base of the Indian glazed objects, whether beads, boxes, or vessels, is a paste of high silica content, usually about 85%. A typical example, in this case a white glaze, is given.[11]

	(%)		(%)
Silica	86.28	Soda	1.21
Alumina and iron oxide	7.78	Potash	
Lime	2.35	Ignition loss	2.05
Magnesia	0.61		
			100.28

[4] W. M. Flinders Petrie, The Arts and Crafts of Ancient Egypt, pp. 108 and 115.

[4a] Guy Brunton and G. Caton-Thompson, The Badarian Civilization, p. 27.

[5] A. Lucas, Ancient Egyptian Materials, pp. 31 and 40–41; John Marshall, Mohenjo-Daro and the Indus Civilization, Vol. 2, p. 579.

[6] Neuberger, Technical Arts, p. 139.

[7] Ernest Mackay, "Report on the Excavation of the 'A' Cemetery at Kish, Mesopotamia," Field Museum of Natural History, Anthropology, Memoires, Vol. 1 (see index "Glaze").

[8] Flinders Petrie, Arts and Crafts, pp. 107–19.

[9] A. Lucas, Ancient Egyptian Materials, p. 31.

[10] H. Frankfort, Tell Asmar, Khafaje, and Khorsabad, *Oriental Inst. Communications*, No. 16, pp. 48–53.

[11] Marshall, Mohenjo-Daro, Vol. 2, p. 578.

The paste, which differs very little in composition from the glaze analyzed above, was pressed into molds without an adhesive. There is some evidence of the use of cloth in forming the body, for the mark of the material still remains after it was burned in the firing. This basic paste seems in many cases to be crushed steatite, which was pressed into the molds and then slightly retouched with a tool before glazing. The paste was fired at about 1200°C. Slabs of unused paste similar in shape to those discovered in Egypt were also found at Mohenjo-Daro.[12]

The glaze was usually colored with copper oxide but manganese was also used and occasionally the two were combined to form attractive patterns. Two coats of glaze of different colors were employed.

A knowledge of glass usually predicates a knowledge of glaze. That glass followed glaze in Egypt we know, and in Mesopotamia pieces of glass, definitely identified as such, have been found dating about 2600 B.C.[12a] Not until about 1500 B.C., however, did glass become at all common in either country. Mesopotamian glaze seems to have appeared at a later date than in Egypt but direct connections are not easy to discover. The use of glaze as a decorative element in architecture was much later than in Egypt and glazed pottery was not common until Achaemenian or Hellenistic times.

Paste was in use in Mesopotamia before 3000 B.C., for whorls, ornaments, seals, beads, and amulets of that material were found at Jemdet Nasr as well as in the later Kish "A" cemetery.[13] Paste beads have been reported from the Third Dynasty of Ur (about 2290–2183 B.C.).[14] By about 2200 B.C., glaze was utilized for small objects at the great city of Ashur in northern Iraq. Pottery covered with a light blue-green glaze, probably alkaline in character, was found at ancient Nuzi nearby, in excavated strata which date to about 1400 B.C.[15] One sherd from Ashur suggests that glazed pottery was in use there as early as 1300 B.C., but not until the discovery of tin glaze about 1100 B.C. did the use of glaze as a decorative material become common. Polychrome glazes were employed on a pottery base, and more rarely on paste, in the creation of vessels and figurines.[16] The difficulty of streaking had been overcome so that elaborate and multicolored scenes full of action could be depicted. Besides animal and plant forms, geometrical ornament in varied colors and outlined in black was used. Pottery similar to the Assyrian examples from Ashur was discovered at Nippur.[17]

Chance has fortunately preserved for us from the great library of Ashur-bani-pal, King of Assyria, 668–626 B.C., a series of formulas for the manufacture of paste, paste glazes, and possibly glass. The translation of these tablets is an extremely difficult task and we are as yet far from a satisfactory solution to many of the problems which present themselves. When the great Assyrian dictionary of the Oriental Institute is completed we may hope to improve upon the present rendering. These recipes are written in cuneiform upon clay tablets and are probably copies of earlier works, just how much earlier we do not know. Two samples must suffice to show the general characteristics of these interesting formulas.

If clear (ibbu) blue glaze is for thee to make, thou shall crush separately

10 mana* of sand
15 mana of alkali-ash
1⅔ mana of styrax gum.

* One mana is about one and one tenth pounds, a shekel one sixtieth of a mana, and a kisal a small weight something less than half a shekel.

Thou shalt mix them together, and put them down in the furnace whereof the floor of the apertures is cold, and settle (them evenly) between the apertures. Thou shalt keep a good, smokeless fire burning until [the "metal"] is at a white heat; (then) thou shalt take (it) out and let (it) cool: thou shalt again crush (it): thou shalt collect (it)

[12] For a quantitative analysis of this material, Marshall, Mohenjo-Daro, Vol. 2, pp. 574–75; numerous other complete analyses of paste and glaze are given, *op. cit.*, Vol. 2, pp. 514, 576, and 577–78.

[12a] H. C. Beck, "Glass before 1500 B.C.," *Ancient Egypt*, Part 1, pp. 7–21 (1934); this careful study, including microscopic examination of all known early specimens, should serve as a warning to archaeologists against hasty identification.

[13] Mackay, Report on Kish "A," Vol. 1, pp. 43, 45, 184, and 193; from Jemdet Nasr, *idem*, pp. 273, 274, and 290.

[14] L. C. Woolley, "The Excavations at Ur," *Antiquaries Jour.*, **5**, 19 (1925).

[15] From examples and information furnished by the excavator, the late Professor Edward Chiera.

[16] W. Andrae, Coloured Ceramics from Ashur (vessels), pp. 33 *ff.*; (clay figurines) pp. 59–61; (paste figurines) p. 61. Dr. Andrae (p. 35) mentions a glaze of lead or natron but gives no analyses or indication that they had been made.

[17] Now at the Museum of the University of Pennsylvania. The character and decomposition of these glazes suggest that they contain tin but this is merely speculation until proved by analyses.

into a clean melting-pot: thou shalt put (it) down into the furnace which has been let grow cold: (then) thou shalt keep a good, [smokeless] fire burning until it [liquefies]: (then) thou shalt [pour] it on burnt brick, and its name is ". . . ."[18]

The Making of Moulded [Purple or Violet] Glass. Thou shalt keep a fire burning in the furnace for seven days; (then) thou shalt add to

1 mana of tersitu ("blue frit")
3 mana of tarabanu šadda (manganese?)
10 kisal of sirsu—glass, "which . . ."
5 kisal of chalk (or lime) of the sea, of the middle [of the sea?]
Cinnabar
2 kisal of salt(peter)
3 shekels of arsenic
5 kisal of male red alum
6 kisal of orpiment
6 shekels of styrax gum

and thou shalt crush it again, and collect (it) in a mould. Uknu m[erku . . . .] will come out.[19]

A blue paste could, of course, be easily produced by the addition of copper and indeed recipes for this are given. Among the materials which the Assyrians had at their command, as far as we may gather from these tablets, were the following: sand, alkali-ash, styrax gum, copper (a recipe is given for the preparation of copper oxide), chalk, saltpeter, manganese, tin, shells, lead, antimony, gold, salt, and if our identifications be correct, cinnabar, alum, orpiment (trisulfide of arsenic), realgar, ferric oxide, and cadmia. Quite a respectable list!

We are told how the furnace should be prepared, what sort of wood should be selected (a real problem in Mesopotamia), how to tell when the fire is hot enough, and we are given additional recipes for glazes and possibly glass and artificial gems.

III. Early Glazed Brick

The hanging gardens of Babylon were far more marvelous to Babylonian eyes than to visitors accustomed to the sight of mountainous country. But the monumental Ishtar Gate and Processional Road, gorgeous with colored reliefs of bulls and dragons, must have made even the most traveled catch their breath. Certainly that is the effect of the restoration in the Staatliche Museum in Berlin where almost the entire gate has been rebuilt. This gate was the work of one of the last great kings of Babylon, the grass-eating Nebuchadnezzar of Bible fame, who ruled from 604–562 B.C. On either wall, arranged in some thirteen horizontal rows, were reliefs of bulls and the "dragon" of Babylon,[20] some in simple relief of baked brick, some in flat glaze, and still others in glazed relief. The total number of such figures must have been greater than 575. In the Assyrian and Babylonian periods the glaze was placed upon brick made of baked clay but in Achaemenian times both at Persepolis and at Babylon the brick are not of clay but an artificial mass of lime mixed with sand.[21] While we do not know precisely how these reliefs were made, the work was obviously very carefully planned. The first figure must have been modeled as a unit either flat on the ground or on a temporary wall. Molds were then prepared for each brick and the brick thus shaped were fired. The contours were then outlined with a black glaze and the designs filled in with color. In the case of the Persian work, the black glaze used has a higher firing point than the colors and thus has remained intact and in slightly higher relief. On the Babylonian and Assyrian work the black often fused with the colors during firing. In these processes each brick had to be treated as a separate unit and to avoid confusion they were numbered in rough glaze on the upper side. A figure was placed on either end to indicate the adjacent brick and the number of the row was written on the front edge. To prevent distortion of the reliefs and the appearance of excessive mortar on the face, the brick of the Persian reliefs were made slightly wedge-shaped.

In the palace of Sargon of Assyria (722–705 B.C.) near Mosul, Iraq, glazed brick were used in profusion. Winged genii, lions, bulls, ravens, trees, and plows or seeders were all represented on the walls discovered by the French about 1850[22] and recently uncovered again by the Oriental Institute.[23]

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[18] R. Campbell Thompson, On the Chemistry of the Ancient Assyrians, p. 58; *Ceram. Abs.*, **5** [2], 43 (1926). H. Zimmern, "Assyrische chemisch-technische Rezepte," *Zeits. Assyriologie*, **36**, 177–208 (1925).

[19] Thompson, *op. cit.*, p. 61.

[20] Examples in the Oriental Institute and the Metropolitan Museum.

[21] On the Ishtar Gate and the technique employed there, R. Koldewey, The Excavations at Babylon, trans. by Agnes S. Johns, pp. 26–49, 104–107 and the publications of the Deutsche Orient-Gesellschaft. For the reliefs from Susa, M. A. Dieulafoy, L'Acropole de Suse, pp. 274*ff*.

[22] P. E. Botta and E. Flandin, Monument de Ninive, Vol. 2, plates 155–56; *idem*, Vol. 5, pp. 59 and 171; Victor Place, Ninive et l'Assyrie, Vol. 1, pp. 116–20; *idem*, Vol. 2, 84–86; *idem.*, Vol. 3, plates 14–17, 21, 24, and 26–31.

[23] H. Frankfort, Tell Asmar, Khafaje, and Khorsabad, *Oriental Inst. Communications*, No. 16, pp. 97–98.

The Elamites probably learned the art of glazing from the Assyrians and we find at Susa in Persia remains of reliefs from that period in flat glazed brick. Paste beads, glazed statuettes, vessels, and other small objects[24] dated somewhere between the 6th and the 11th Centuries B.C. were also found there.

The technical and artistic skill necessary to produce such excellent reliefs of glazed brick was largely gone by the 3rd century B.C. At Uruk in southern Mesopotamia, work from that period which can not be compared with that from the Ishtar Gate was discovered.[25]

IV. Later Glazed Pottery

As we have seen, the common blue-green glaze, the invention of which is sometimes credited to the Parthians, was in use at a very early date in both Egypt and Mesopotamia. This glaze became still more popular in Hellenistic times; it continued throughout the Parthian epoch; it lasted well into the Sasanian era. The ceramic ware of these periods is difficult to date for we lack properly excavated material. Shapes were seldom abandoned and the pottery of the later Orient becomes a compendium of earlier forms plus the newly imported ones from the West.

In the relatively small area excavated thus far at ancient Seleucia on the Tigris[26] just below Baghdad, four hundred and seventeen distinct shapes of pottery were recorded in two years' work. This large number of types, plus the fact that there is but slight difference in glazes until Arab times, makes identification difficult. Differentiation between ceramic ware of closely related regions or periods can not be based solely upon any one characteristic, but must include shape, color, technique, and glaze. For example, more careful workmanship and a slightly more vivid green glaze are almost the only characteristics which distinguish the Hellenistic from the Parthian pottery at Seleucia. Greater care was exercised in compounding and applying glaze in Hellenistic times than in the Parthian period; this is also true of all technical processes such as firing and shaping. Nevertheless the pottery from both epochs is one continuous series in technique and physical appearance, although forms with even remote Hellenistic influence number less than 5% of the total found.

The Parthian pottery is of special interest, first because until recently no attempt has been made to catalogue it and very little has been published in any form; second, because of its influence on Roman pottery from the Near East and its possible relation with the green glazed ware of the Han dynasty in China. In appearance good specimens of the Parthian green glaze so resemble a lead glaze that the most expert ceramic worker is deceived, but analyses have shown that no lead glaze was used at Seleucia in the Parthian period. Since Parthian ceramics from other sites in Mesopotamia display a glaze identical in appearance, we may tentatively assume that lead glaze was then unknown. Nor does it seem to appear in early Sasanian ware.[27] My own observation tends to support Brongniart's belief[28] that lead glazes were not common until Arab times.[29] We must also recognize that, in general, until the time when our knowledge of ancient glazes is much further advanced than at present, attempts to guess the composition of a glaze from its appearance merely exposes the guesser to serious criticism especially if such assumptions are utilized as historical evidence. Even specimens entirely free from decomposition present the same difficulties.

(1) Parthian Pottery

How was the pottery from the Parthian period made and the glaze applied? The evidence is

[24] G. Jéquier, "Travaux de l'hiver 1898–1899," Mémoires, Vol. 1, Délégation en Perse, ed. J. de Morgan, p. 123 and plate VI; *idem*, Vol. 7, R. de Mecquenem, "Offrandes de Fondation du Temple de Chouchinak," p. 61*ff*; J. M. Unvala, "Three Panels from Susa," *Révue d'Assyriologie*, **25**, 179–85 (1928).

[25] J. Jordan, Uruk-Warka, *Wissen. Veröff. der Deut. Orient-Ges.*, Vol. 51, p. 18 and plates 48–52. For further information and bibliography on glazed brick, see P. V. C. Baur in The Excavations at Dura-Europos, Fourth Season, ed. P. V. C. Baur, M. I. Rostovtzeff, and A. R. Bellinger, pp. 48–53.

[26] The remarks on the excavations at Seleucia under the direction of Professor Leroy Waterman, University of Michigan, are drawn largely from Debevoise, Parthian Pottery, chaps. III–IV.

[27] Analyses of the Sasanian glazes from Kish are discussed in some detail on p. 291.

[28] A. Brongniart, Traité des Arts Céramiques, (3rd ed.) Vol. 2, p. 90; H. Blümner, Technologie und Terminologie der Gewerbe und Künste bei Griechen und Römern, Vol. 2, pp. 88–89; *cf.* H. A. Mazard, "De la connaissance par les anciens des glaçures plombifères," *Musée archéologique*, **2**, 373*ff*. (1879), cited by H. B. Walters, History of Ancient Pottery, Vol. 1, p. 130, note 3 and others not available. There was no lead in the glaze on a brick picked up at Babylon which was identical in color and appearance with those of the Ishtar gate. An analysis was made by Dr. H. W. Nichols of the Field Museum, Chicago.

[29] *Cf.* the early Arabic material from Samarra, F. Sarre, Die Keramik von Samarra, pp. 95–100, where lead glaze is reported, but no analysis is given.

scanty and requires direct contact with the pottery and knowledge of primitive methods of pottery making to be appreciated. Let us take the material from Seleucia as typical in many of its technological aspects of the later Oriental ware. The bulk of the pottery came from a great house which occupied an entire block, a house which probably belonged to some wealthy merchant family. The structure was rebuilt three times, each time after a more or less complete destruction during an invasion or revolt and it underwent many remodelings. Besides extensive suites for the family, the parlors, courtyards, and the separate quarters for the women, around the outer portion small shops were permitted, tiny booths unconnected with the remainder of the house where merchants might sit just as they do in the nearby Baghdad of today.

Huge quantities of pottery of every imaginable character were found in this house. Although only complete lamps were kept, these averaged between one and two thousand a year; pot covers, storage jars, and cooking pots would probably add another thousand while vessels complete enough to permit a drawing to be made numbered about eight hundred a season. This means that in five months of excavation, in the restricted area of half a city block, with about three hundred men employed, we found some three thousand pieces of pottery which were reasonably complete, taking no account of the tons of sherds which were discarded.

(2) The Potter's Wheel Clay of a suitable nature for pottery is available not far below the surface of the ground at Seleucia and after the necessary levigation this doubtless served for most of the pottery. With a few exceptions to be mentioned afterward, the Seleucia pottery was thrown on the wheel. The potter's wheel may have been similar to the modern Near Eastern one, a double wheel, erected vertically on an axle and turned by the pressure of the foot on the lower disk. On the other hand, the type seems never to have attained widespread use in the ancient Orient, probably because the earlier and simpler form of spun or hand wheel needed no improvement for the Oriental who is more at home squatting on the ground than seated in a chair. Speculation is idle without more evidence than is yet forthcoming.

A few vessels for storage purposes, some pot covers, tiny cosmetic dishes, and certain irregular shapes, impossible to create on the wheel, were made by hand. Some of these were made in a plaster or clay mold, others were thrown on the wheel and then decorated by hand. Some jars were a combination of wheel- and hand-made sections. Obviously a number were made in segments upon the wheel and then stuck together with a thin slip, such as the large canteens (pilgrim flasks).

When the completed pot was removed from the wheel with the aid of a piece of string, it was set aside to dry before firing. The marks of the string show plainly on many of the vessels and the method is still in use in Baghdad and elsewhere. If a very thin ware was to be produced, the walls of the pot were pared to the correct thickness with a knife after the drying had progressed sufficiently. If the finest quality of work was desired, the vessel was then put back upon the wheel and the marks of the cutting smoothed away. Strong usable pottery with walls about $^{3}/_{32}$ inch was thus produced. Possibly some method of turning down the vessels upon the wheel or in a sort of lathe was in use, for certain of the pieces of thin ware show no signs whatever of knife marks, although they are too thin to have been thrown directly on the wheel. Handles were stuck on after drying had progressed to the proper point, or if the vessel was too delicate to allow rough treatment, they could be attached with a thin slip.

The kilns were probably fired with bundles of camel thorn in the same manner as the modern Mesopotamian brick kiln. About Baghdad there is little wood and the palm tree is not suitable for the purpose. Camel thorn makes a very hot fire, though not a lasting one, but cheap labor and immense quantities of thorn make it entirely practical. Pottery was piled up in the kiln, one piece above another, as the spur marks on the top and bottom of many vessels prove. The design of these spurs seems to have undergone little change over a long period of time. Identical three-pronged examples were found at Tell Asmar,[30] dated about 2500 B.C. and at Seleucia dated about 200 A.D. Modern spurs are also similar though the shape was only rediscovered at a relatively recent date. Sometimes chunks of clay were rapidly molded with the fingers into oblongs, triangles, and other suitable shapes to

[30] Now in the Museum of the Oriental Institute, University of Chicago.

keep the vessels erect and hold them away from the sides of the kiln and from one another.

One kiln was found at the great house in Seleucia not far from the small shops and the street. The structure was shaped like an elongated horseshoe, with clay side walls about one meter of which remained. The last firing had been completed, and the spurs and lumps of clay which separated the vessels were piled in one corner of the room. The kiln had been cleaned, perhaps in preparation for the glazing of the canteens baked in the last firing and piled carefully at one side.

V. Composition of Glazes

The glazed pottery at Seleucia was dipped into a colloidal suspension of glaze and many examples show the base, the portion which the hand would naturally grasp, still unglazed. Few examples of two-color glazing occur; of these the lamps are the most important. Many of the nozzles of the better lamps were dipped in a peculiarly hard blue-green glaze, whereas the body was covered with a much less durable one. Pottery was sometimes dipped a second time and fired again, as the drops on both top and bottom prove.[31]

Contrary to expectations, lead glaze does not appear on the Parthian pottery from Seleucia.[32] Most of the glazes analyzed were alkaline silicates with an oxide added for color. About 55% silica was commonly present, together with impurities ordinarily to be expected from clay. Clay may have occasionally been added to produce the mat surface which certain vessels, apparently free from decomposition, exhibit. Stannous oxide, manganese dioxide, and cupric oxide were utilized as coloring agents. The use of manganese appears to have been a trade secret held by one potter, for every single example with manganese glaze has the same shape.

The following table gives quantitative analyses of three representative glazes from Seleucia.[33]

Sherd A, from Level II (116–43 A.D.), is typical of the majority of glazes found at this site. The pottery body is cream in color, of medium texture, and the perfectly preserved glaze is dark green and glassy in appearance. The glaze had been previously identified by a number of persons as containing lead! This example, like B and C, was part of a vessel.

Sherd B, from Level I (200–116 A.D.), has a buff body, medium texture, and is covered with a chocolate brown glaze, slightly iridescent from decomposition. A manganese glaze similar in appearance was common in the Arabic period.

		A (%)	B (%)	C (%)
Silicon dioxide	SiO_2	56.32	54.20	58.46
Aluminum oxide	Al_2O_3	7.56	2.29	6.33
Ferric oxide	Fe_2O_3	0.80	3.49	1.53
Calcium oxide	CaO	12.12	4.80	1.46
Magnesium oxide	MgO	5.53	4.30	0.66
Manganese dioxide	MnO_2		4.77	
Sodium oxide	Na_2O	9.44	3.80	6.22
Potassium oxide	K_2O	2.84	2.88	1.92
Cupric oxide	CuO	3.97		1.23
Nickelous oxide	NiO	1.03		
Stannic oxide	SnO_2			8.20
Loss on ignition	CO_2, etc.	0.85	18.90	15.20
		100.46	99.43	101.21

Sherd C (level undetermined but similar examples fairly common in all levels) has a cream body, medium texture, with an opaque white glaze which is slightly crazed. This is a true tin glaze.

Early Sasanian glaze is similar in appearance to that of the Parthian period both when fresh and decomposed. In a light green fragment from Kish, portions of which were light yellow, sodium, calcium, and silica were found; in lesser quantities, iron, alumina, and traces of magnesia. The glaze seems to be a silicate of sodium and calcium, colored green by small quantities of iron. Copper, lead, and manganese were not present. The variation of color from green to yellow does not appear to be the effect of age but the consequence of a variation in the quantity of aluminium and alkali. Another sample of a much darker green color, very much like the Arabic glaze, gave a similar result.[34]

The question of the relation of the green Chinese glaze of the Han dynasty (*cir.* 202 B.C. to 220 A.D.) to the similar Parthian one is an intriguing point. The Chinese product is almost universally assumed to be a lead glaze and this is the principal argument for the belief that its origin lay in the similar Parthian "lead" glaze.

[31] An example is on exhibition at the Art Institute, Chicago.

[32] See the analyses which follow and ten qualitatives in Debevoise, Parthian Pottery, pp. 31–33.

[33] Debevoise, Parthian Pottery, pp. 33–34.

[34] This preliminary information on the glaze from the Sasanian site at Kish was made available through the courtesy of Dr. H. W. Nichols, who made the analyses, and the late Dr. B. Laufer, both of the Field Museum, Chicago. I presume the analyses will appear in some future publication by the Museum on Kish.

Certainly the Chinese glaze appeared almost simultaneously with the opening of trade and communication with the Parthian Empire. But the Parthian glaze did not contain lead; did the Chinese? The only analysis of the early Chinese glaze on a pottery base which I have thus far found is one with over 65% lead oxide and only about 30% silicate. This is a brilliant glassy glaze of a bottle-green over a red pottery base.

	(%)		(%)
Silica	29.91	Copper oxide	2.60
Lead oxide	65.45	Lime	0.94
Iron oxide	0.81	Alkalis (Na_2O, K_2O)	0.00
			99.51*

* H. W. Nichols, "Report on a Technical Investigation of Ancient Chinese Pottery," in B. Laufer, The Beginnings of Porcelain in China, *Field Museum Pub.*, No. 192, p. 93.

Such a glaze might well be of local origin, quite possibly discovered by the accidental glazing of a crucible.[35] The glaze which appeared on the later porcelaneous ware is an alkaline silicate glaze but of somewhat different composition than glazes thus far analyzed from Parthian Seleucia. This glaze is greenish yellow, a little brown in the thicker areas.

	(%)		(%)
Silica	54.17	Magnesia	2.04
Alumina	14.16	Soda	5.49
Iron oxide	4.36	Potash	0.00
Lime	19.05		
			99.27†

† Nichols, *op. cit.*, p. 90.

If, therefore, the earliest Chinese glaze is a lead one, then it can hardly be derived from the alkaline silicate Parthian glaze. If this early Chinese glaze is assumed to be a local discovery, then the Chinese alkaline silicate glaze on the porcelaneous ware is not only much later but also of different composition than the Parthian one. Obviously more analyses are necessary. Connection does exist between the Parthian and the Han pottery, but for the present other evidence than the composition of the glaze must be used to prove the point.

But let us return to the Parthian pottery from Seleucia. All the glazes there are apparently low fired, roughly about 1000 to 1200°C. The two commonest colors are blue and green with all the intermediate shades made by combinations. No cobalt has been found at Seleucia. An occasional example exhibits scaling of the glaze, a defect caused by improper adjustment between glaze and body. On the whole, however, this difficulty had been remarkably well overcome.

The size of the object to be glazed was no obstacle to the potters at Seleucia or Nippur[36] to the south, for glazed coffins about six feet in length were found at these sites. The coffins were enriched with a molded decoration of leaves and grapes or figures of warriors and Anahita, the Mother Goddess.

Unfortunately the technique, so highly developed at Seleucia, did not become a part of western craftsmanship although the Arabs made use of it in their remarkable work of the 7th to the 14th Centuries A.D. It remained to be rediscovered in the workshops of the western world at a much later date.

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[35] Many of these suggestions are due to the kindness of Dr. Nichols who was much interested in the problem; *cf.* Laufer, *op. cit.*, p. 147, on the possibility of accidental origin.

[36] A coffin from Nippur is on exhibition at the Museum of the University of Pennsylvania, Philadelphia, Pa.

THE BRONZE AGE POTTERY OF GREECE*

By Hetty Goldman[1]

I. Introduction

If in ordinary life we are impressed by the lack of permanence in human affairs, the archeologist who seeks underground for traces of vanished civilizations is equally impressed by the durability of certain material products of human industry. A wall once built rarely disappears so completely that even after the lapse of thousands of years we can not trace, however faintly, its essential outline. Indeed, unless man deliberately tries to wipe out his footsteps on the sands of time, they are likely to survive in some form until the active spade and the discerning eye again find them and a written record gives them a new permanence. But of all the products of man, pottery, while one of the most fragile, is also the least corruptible, and any one who builds or turns a vase may well feel that he is providing an immortality for his art which no other artist may claim in like degree. Apelles and Polygnotus among ancient Greek painters have left us their names and nothing else, but the designs on the vases of Amasis, to mention but one of dozens of potters, have come down to us literally as fresh as the day they were created. For the civilization of classical Greece, pottery is but one and a minor source of evidence, but as soon as we try to deal with the periods preceding the time of great buildings and of written records, pottery is always of major importance and often through its stratified layers in the earth our only means of defining successive cultural phases. "By their works shall ye know them" has a very special and very literal meaning for the prehistorian.

Note: The author has chosen to write about the Bronze Age pottery of Greece for two reasons: first, because she has spent the greater part of four years in Boeotia, excavating a site of the Bronze Age, and two more in publishing the results; and second, because it is one on which it is difficult for even the interested public to get much information. The remains of the earlier phases of the Bronze Age are for the most part very fragmentary, and such vases as have been pieced together are found only in the museums of Greece, and even there more frequently in the provincial museums than in those of the centers frequented by travelers. Our American museums are able to show actual examples, with the exception of a very few pieces only of the last phase of the Bronze Age which will be better known to some as the great Mycenaean Age. And yet for the modern ceramic artist, the shapes and techniques of the pottery of the Early and Middle Bronze Age may prove of interest. By means of illustrations the author hopes to bring them before you more concretely than she could otherwise hope to do.[2]

II. The Bronze Age Culture

The Bronze Age peoples were not the first of whose culture we have remains. They were preceded by the neolithic, whose ceramic achievements were not inferior; from some points of view they were superior in technique and sense of design to those of the later period. But this does not fall within the scope of this paper.

All cultures, like the life of all individuals, fall naturally and logically into three periods: birth, maturity, and decline. Actually there are three periods of the Bronze Age, within each of which one may observe this tripartite development. But in relation to each other they represent not the growth and decline of a single culture but three successive cultures whose unity consists only in the fact that they were all bronze-using. Chronologically they fall between the age of the neolithic people who made exclusive use of stone for weapons and implements and that of the users of iron. Their unity is, in other words, external, not genetic In time, the Bronze Age of Greece may be said to occupy the years approximately between 2500 and 1100 B.C.

(1) The Early Bronze Age

We have reason to believe that the people of the Early Bronze Age migrated westward from Asia Minor and spread slowly over the smaller islands of the Ægean Sea to Crete and the mainland of Greece. When they reached the continent they settled among and mingled with the earlier inhabitants and adopted from the tradition of the neolithic age certain simple forms which represented a taste markedly in opposition to that of the early users of metal in those parts of Asia Minor which have been archeologically explored.

* Presented at the Annual Meeting, American Ceramic Society, Cincinnati, Ohio, February, 1934 (General Session). Received March 30, 1934.

[1] Excavator in Greek Lands for the Fogg Museum of Harvard University.

[2] Unfortunately the photographs can give no idea of color. Those interested will find ample colored illustrations in two books: C. W. Blegen, Zygouries; H. Goldman, Excavations at Eutresis in Boeotia.

The early type of bowl is so simple and so adapted to the hand which fashioned and held it that it may well be thought of as an extension of the human hand itself. Figure 1 shows the

FIG. 1.

product of this first Bronze Age which most closely approximates to the primitive form. It has preserved the simplicity of the neolithic bowl with its rounded base made to fit into the cup of the hand, while the top has been drawn together to form a less open vessel. Its beauty lies

FIG. 2.

in its perfect adaptation to use and in the brilliance of its surface which had been polished with a stone or flat bone and to which constant use had added a greater luster.

In order to understand the contribution of Asia Minor, we must look simultaneously at such pots as Fig. 2, which is from the mainland of Greece, and those of Fig. 3, which are from Troy and represent the Asiatic type. The pitcher found in Greece has a body of considerable grace and a slanting rim which flows rhythmically into the line of the handle. In the Asiatic form there is

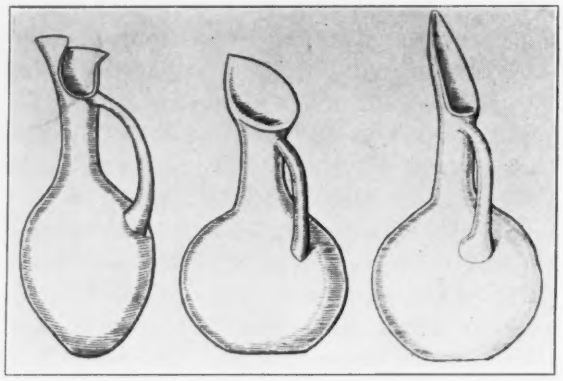


FIG. 3.

extravagance and a lack of proportion in body and neck. In the contrast between these ceramic products it is perhaps not far-fetched to see already the divergent tendencies of two continents, Europe and Asia, which thousands of years later met to fight for supremacy on the battlefield of Marathon. Figure 4 shows again a form which

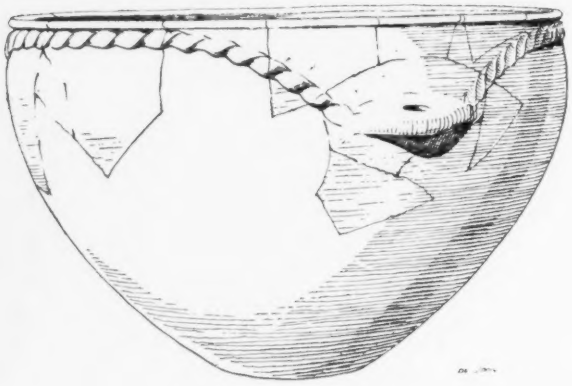


FIG. 5.

is rooted in Anatolian psychology. Possibly an abstraction of animal forms, such as birds with long beaks, may have suggested these long uptilted spouts. This footed bowl, which is known among archeologists by the somewhat inappropriate name of a "sauceboat," went through many transformations and modifications until better proportions and a steadier pot were evolved. The most successful type was lower with broad

ring-base and shorter, almost vertical spout. The surface was either a uniform, fairly lustrous glaze, black, brown, olive-green, or dark red, or a polished slip of variegated color. The slipped and polished bowls reached a high degree of technical perfection. The walls of the vessels are exceedingly thin and baked so hard that they give forth a metallic clink when they strike another object. The early potters were never as much concerned with ornament as with shape, and their means were simple: incision, plastic

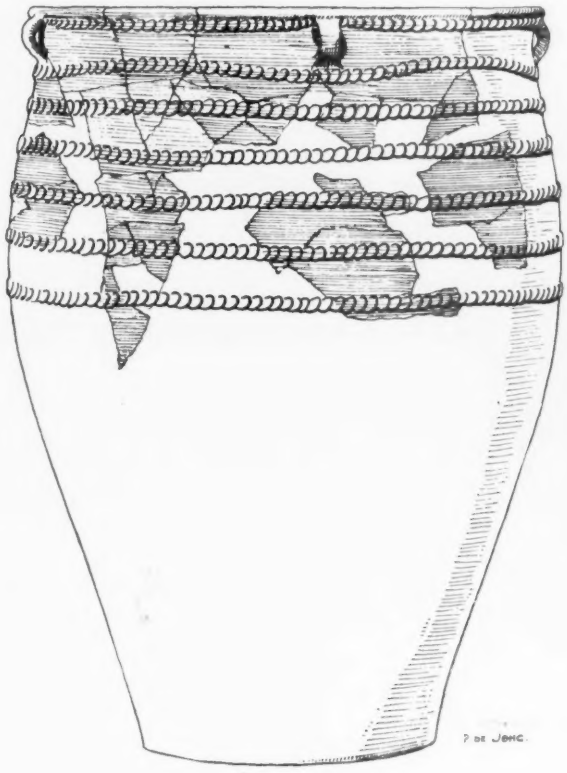


FIG. 6.

relief bands, and painted design sparingly used. Incision and plastic came first; painting was introduced only toward the end of the Early Bronze Age. If we look at such bowls as Fig. 5 we see immediately that the plastic ornament is a translation into clay of the rope with which, doubtless, vessels of the size of the big jar, Fig. 6, were actually bound. On the latter jar the texture of the rope is not as faithfully reproduced as on Fig. 5, rows of overlapping disks taking the place of the twisted rope, but the rope undoubtedly furnished the inspiration for both. Figure 7 shows again how too exuberant fancy may by exaggeration spoil a simple and adequate decorative motif. The rope in countless zigzagged strands covers the round-bellied pot vertically, trailing off into space near the bottom, with no suggestions of a functional purpose.

Paint was always used with great moderation and exclusively for simple geometric designs, such as lattice-work bands, cross-hatchings of great variety, and parallel lines in which the varying thickness of the lines themselves are relied upon for decorative effect. Figure 8 is a tankard of elegant form and with certain subtleties absent from the earlier ceramic products. The rim flares very slightly and is gently and somewhat irregularly fluted. Originally the whole surface

FIG. 7.

was covered with a slightly lustrous black glaze on which the design was painted with a dull, somewhat chalky white paint.

The makers of this pottery of the Early Bronze Age lived in closely built villages in two-room houses, the component parts of which were an almost square main chamber with a shallow antechamber. On a high stone sockle of substantial dimensions thick walls of unfired brick were raised and topped with a flat roof of thatch and clay. Almost everywhere their villages ended in flame and ash, and frequently the very foundations were torn asunder and the stones scattered. We can not doubt that invaders fell upon them, sacking and plundering as they went. For plunder there were richer objects of gold, silver, and bronze whose very value doomed them to

FIG. 8.

almost total destruction. A golden "sauceboat," one of the few survivals, has long been on view in the Louvre Museum, and silver and gold jewelry is by no means unknown in burials of this period.

(2) The Middle Bronze Age

Who the invaders were who created the Middle Bronze Age culture of Greece and whence they came is by no means certain, but the probabilities are that they entered the country from the north or northeast. That they were a quite different people is clearly shown in many ways. Their villages were open with big courtyards and byres in which the ovens and storage bins were placed. Their houses were smaller and narrower with gabled roofs and more often than not apsidal ends. Instead of disposing of their dead in ossuaries outside the limits of the villages they indulged in the unsanitary habit of burial under the floors of houses or in pits in the courtyards. They were apparently poorer than their predecessors and cut off from trade with their neighbors, for the precious metals are rarely found in their homes and graves.

In spite of the fact that they themselves, as far as our evidence goes, had little gold and silver and made a very restrained use even of copper and bronze, they must have known metal shapes. Perhaps they were common in the homes from which they had originally migrated to Greece. Figure 9 shows, unfortunately poorly preserved, the type of high-stemmed goblet with hollow foot covered with horizontal rills which is the most

FIG. 9.

characteristic product of the Middle Bronze Age. The identical shape appears everywhere and is found by the hundreds. The material is a very well levigated clay with a slightly polished gray surface soapily smooth to the touch. It goes by the name of Minyan ware. The potters had brought the art of firing to high perfection and achieved almost invariably a very uniform dark gray color.

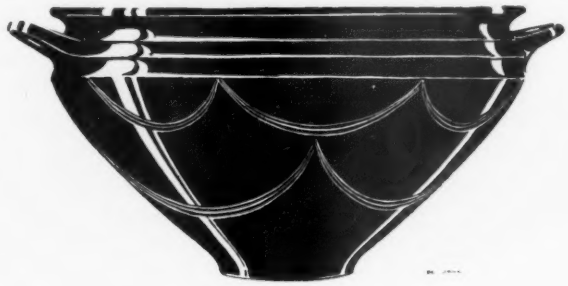


FIG. 11.

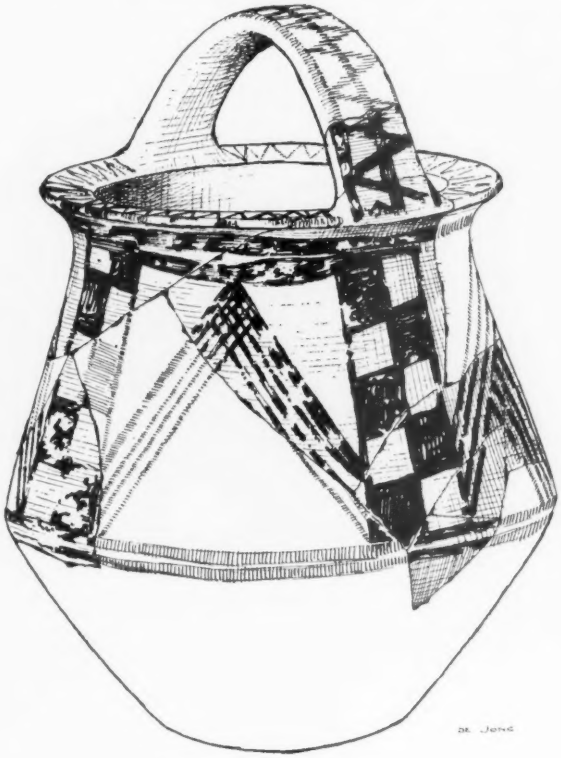


FIG. 12.

Experiments have shown that the gray color is due to reduction and not to any substance added to the clay itself; for it is possible to take a piece and turn it bright red by oxidation. I think that all will agree that this shape with its hollow rilled stem and sharp profiling of the bowl can hardly have been created without a metallic prototype. Indeed, so close is the imitation of metal that even the rivets are frequently reproduced in clay.

Similar to these rather sober vessels were so-called fruit-stands, somewhat shallower and simpler in profile and covered with a brilliant red glaze of which Fig. 10 gives an adequate illustration. Equally striking are the black-burnished bowls (Fig. 11) which with their solid shapes and small, facetted handles, seem nearer to stone than to metallic prototypes. Side by side with this monochrome pottery went the linear-painted ornament on a light ground (Figs. 12 and 13), continuing the tradition of the last phases of the Early Bronze Age. Many new motifs were introduced, the decorated area was greatly increased, and the elements were organized into patterns of bold and striking effect. The paint ordinarily used was a somewhat dull black, but on small vessels, such as Fig. 14, the color may be a pale mauve or nut brown. There can be little doubt that both in the proportioning of the parts of the vessel, base, body, neck, and handles, and in the disposition of ornament, the Middle Bronze Age is in advance of the earlier period, which, however, triumphed in the variety of surface color and in a fresh and somewhat naif ingenuity and experimental spirit in devising

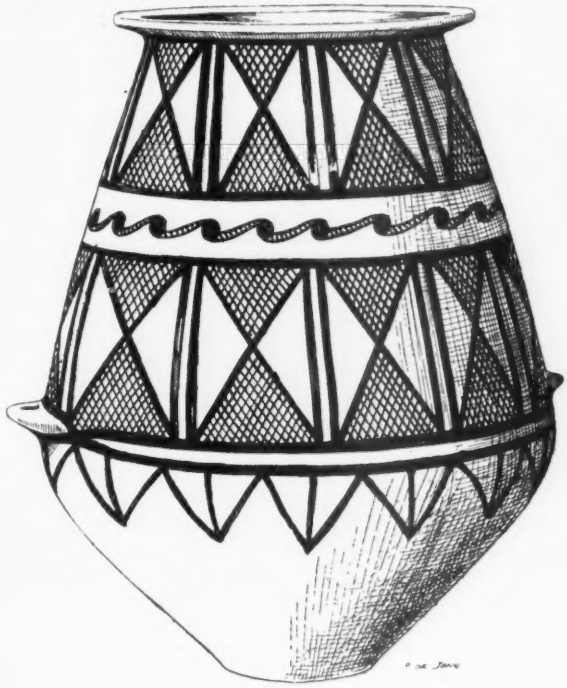


FIG. 13.

shapes. The interest in animal shapes, the so-called zoömorphic vessel, persisted into the Middle Bronze Age, and Fig. 15 offers a good example illustrating the way in which the spout is made to serve as neck and beak. The wing, though greatly abstracted, is clearly indicated in the simple geometric pattern on the sides of the vessel.

(3) The Late Bronze Age For the lover of beautiful design it is a pleasure to reach the Late Bronze Age in this rapid survey of prehistoric Greek pottery. To the south of the mainland, like a missionary of the arts, like a gifted older brother, mature and wise in all the crafts, which included the use of metals, ivory, and faience, lay the island of Crete. Long in contact with Egypt, and through Syria less directly with the Mesopotamian cultural hinterland, Crete, from simple beginnings similar to those of the mainland, had blossomed into a rich and varied artistic expression for which there was a solid basis in her material wealth. The walls of her widespread palaces were covered with frescoes; the long corridors of her storerooms were filled with immense jars of oil and grain and in the floors there were sunken strong boxes, rifled long before the excavator uncovered them, but which must have contained the treasures of ivory and metals from which she fashioned her ceremonial swords and statuettes of gods and votaries.

FIG. 16.

To what point Crete actually gained physical control of the mainland remains somewhat of a problem, but for our purposes it is enough to know that around 1600 B.C. she became for Greece and the Cyclades the arbiter of fashion and artistic style, playing the same rôle that France has played in more modern times. Toward the end of the Middle Bronze Age there is a sudden stirring of the imagination and simple floral ornaments begin to appear. The shackles of the geometric tradition are beginning to be loosened. The Cretans were above all observers of nature. They loved the details of the external world and all the minutiae of her plant and animal life, making them the subjects of their decorative art to a degree which has perhaps never been equalled. Figure 16 swarms with creatures of the sea. Numerous are the vases which show a similar love of plants and flowers. But perhaps the greatest triumph of the Cretan

FIG. 17

Fig. 10. (*Below*). Fig. 14. (*Above*).

Illustrations for "Bronze Age Pottery of Greece," by Hetty Goldman, *The Bulletin* of The American Ceramic Society (November, 1934).

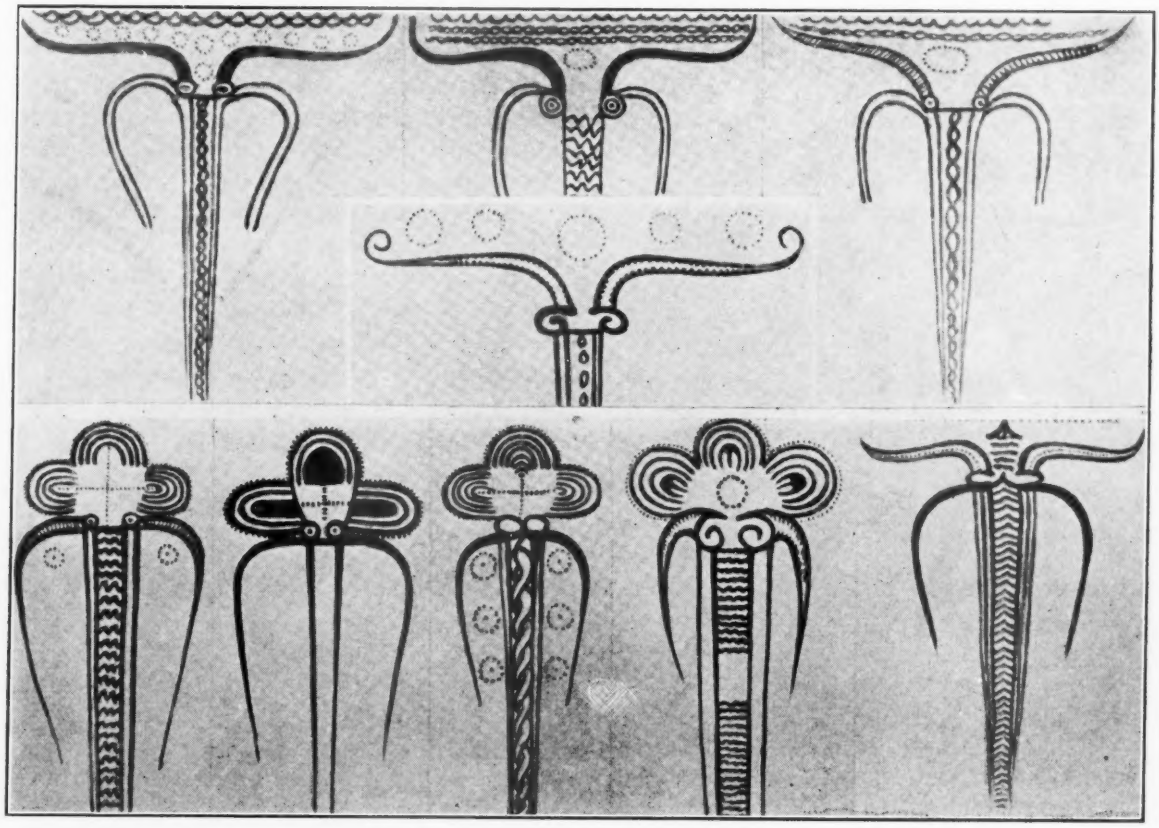


FIG. 18.

potter was achieved in the adaptation of the octopus with its spreading tentacles and goggling eyes to the uses of decoration. The octopus vase of clay, Fig. 17, found in Crete and the beautiful gold cup of the king who was buried in the Argolid of Greece both show the mastery of style achieved by the Cretan artist.

It is not possible to follow the art of the Late Bronze Age in detail, but it is of interest to see what the native mainland artist did with the rich inspiration of Crete. For a while he followed his master closely, and we are able to distinguish the island and the mainland products chiefly by the quality of the clay and the less deft handling of the brush. But gradually the old native love of thinner patterns, of a more rigid symmetry in place of the free distribution of design over an unlimited surface, of the geometric rather than the naturalistic, began to win the upper hand. It would be interesting to trace in detail the course it took, but certain chosen examples will sufficiently indicate the trend of native art. Compare, for example, the highly stylized octopus designs (Fig. 18) occupying the vertical center of high-stemmed cups such as Fig. 19, the symmetrical distribution of parts, the use of geometrical filling ornaments in the

FIG. 19.

body, with the free monster of Fig. 17 in whose glutinous tentacles the body of the vessel seems actually to be held. In Fig. 20 which dates from

the end of the Late Bronze Age, we see the bodies of the birds most unnaturalistically filled with linear ornament and the background already dotted with those conventional ornaments which characterize the "horror vacui" of later archaic

FIG. 20.

Greek times. The freedom of artistic expression, the passionate love of the created world manifested in Cretan art never again flourished on Greek soil, though perhaps, channeled into a different course it may be responsible for the spirit of free enquiry and the scientific discoveries of later Greece. Greek classical art is never riotous. It is something exquisitely composed to decorate a given space; and even when, as in sculpture, the outward boundaries are invisible, we still feel the directing force of the framework in relation to which it was composed.

Crete was not the only center from which an alien art came to conquer Greece temporarily. In the late eighth and seventh centuries B.C., a wave of artistic influence swept over Greece from the Orient, but it, too, gradually subsided; and again the sober decorative instincts of the native Greek triumphed, triumphed to develop with infinite variety and grace the use of the human form and of human occupations and preoccupations as the subject matter of art. Nature, and to a less degree animal life, retreated before the triumph of man himself.

Classical Greece and the Mycenaean or Late Bronze Age, with its naturalistic designs derived from Crete, undoubtedly offer the most brilliant material for study to the modern potter, but some inspiration too may perhaps be gained from the diversified shapes and gay surfaces of the more primitive ceramic products created in the earlier periods of the Bronze Age.

132 EAST 70TH STREET
NEW YORK, N. Y.

MODERN ALADDINS*

BY W. T. LEVITT

I. Introduction

When Scheherezade, wife of the Sultan Shahriyar, related the stories of the Thousand and One Nights and included the story of Aladdin and his wonderful lamp, she most likely did not have in mind a picture of those modern Aladdins, the lampworkers of the glass industry.

These slightly known artisans are truly modern Aladdins, for while they do not rub their lamps and cause a magic genie to appear and fulfill their every wish, yet, by careful manipulation of their blast lamps and their uncanny skill, they perform wonders that seem like magic to the uninitiated.

(1) Lamp Workers Defined

Lampworkers constitute that branch of glassworking which processes glass tubing and glass rod into intricate shapes and forms, using an ordinary air-gas or air-gas-oxygen blast lamp for heating the raw material and fashioning the finished product free hand.

Even as glassworkers in general are divided into numerous branches such as pressers, pipe blowers, casters, ring layers, and various finishers, so also are lampworkers subdivided. Lampworking covers a wide range of activities such as the manufacture of X-ray tubes, museum glasswork, radio tubes and incandescent lamps, glass eyes, Christmas tree ornaments, proprietary medicine vials, neon signs, thermometers, art glass work, some industrial glassware, syringes, and laboratory glassware—to mention but a few of the lampworkers activities.

II. Glass Bulbs

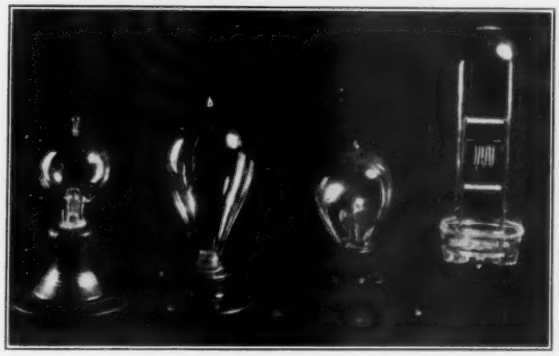
When Thomas Edison secured from Corning Glass Works his first off-hand bulbs and tubing for incandescent lamps, he had only the raw

* A lecture and demonstration of glassworking presented at the Annual Meeting, American Ceramic Society, Cincinnati, Ohio, February, 1934 (Glass Division). Received August 24, 1934.

material for the foundation of an industry which was destined to grow to great prominence. A lampworker was necessary to assemble this material into the finished product. In the early incandescent lamp factories, the hand lampworkers were responsible for almost the entire assembly of the incandescent lamp.

(1) Bulbs Hand Blown in Early Days

Before the introduction of the tipless lamp, the bulbs, as received from the glass factory, were tubulated at the top by hand. This tubulation served as a handle for the next operation in which the filament was hand sealed into the bulb, and later served as an exhaust tube through which the gases were pumped from the lamp. The stems or filament



(*a*) (*b*) (*c*) (*d*)

FIG. 1.—Examples of early types of incandescent lamps contrasted with modern lamp: (*a*) replica of Edison's first lamp, (*b*) glass-stoppered lamp used for lighting the Columbian Exposition in Chicago in 1893, (*c*) experimental lamp with partially insulated filament, (*d*) modern bi-post lamp used in lighting airway beacons.

mounts were also fabricated by hand from tubing. Miniature lamp bulbs, such as are used for illuminating Christmas trees and flashlight bulbs as well as various other small types of lamps, were all blown free hand from tubing. A good bulb blower could blow free hand as high as four hundred one-inch round bulbs in a nine-hour day and keep within a tolerance of plus or minus one millimeter.

The lampworkers in the early days of this industry exhausted the gases from the fabricated lamp by means of an all-glass vacuum pump which they themselves constructed. Modern machine production and automatic equipment have not completely eliminated the lampworker from this field, for the development of incandescent lamps, radio tubes, neon signs, and the diffusion and condensation pumps used for exhausting the gases from this type of ware are still dependent upon the skill of the lampworker.

III. Neon Signs

When we see a tubing machine drawing off more than a mile and a half of tubing an hour, we ponder what is to become of this tubing. Ask the neon lampworker. In eight years, since the

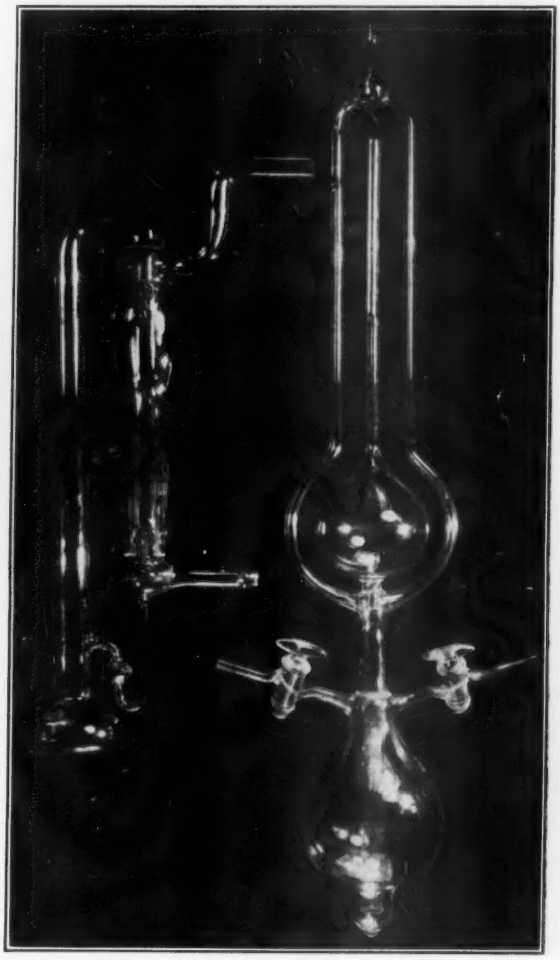


FIG. 2.—Glass diffusion pump and McLeod vacuum gage.

commercial production of this glorified Geissler tube began, there has been sold in the United States for neon sign purposes an average of approximately 750,000 pounds of tubing per year or, roughly, 6,000,000 pounds of tubing for the last eight years. If you have a tendency toward mathematics, you can translate this into linear feet and you will find that lampworkers have bent approximately 1150 miles of neon signs.

Neon signs are the offspring of the Geissler tube which was invented by Heinrich Geissler, a

German instrument maker of the period of about 1850. The Geissler tube consists of tubing bent into intricate shapes with an electrode sealed in at either end. The tubes are filled with various gases and when an electrical discharge is released through the terminals, the tubes will glow in

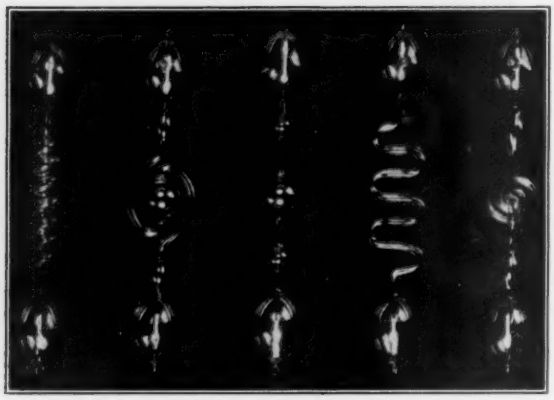


FIG. 3.—Geissler tubes, the original neon signs.

colors depending upon the nature of the gas with which they are filled. Most neon signs are individual in character and shape. In the process of manufacture, a draftsman first lays out the design on paper to actual scale. From this design, templets are made and the neon sign maker bends his tubing to conform to the templet. The elec-

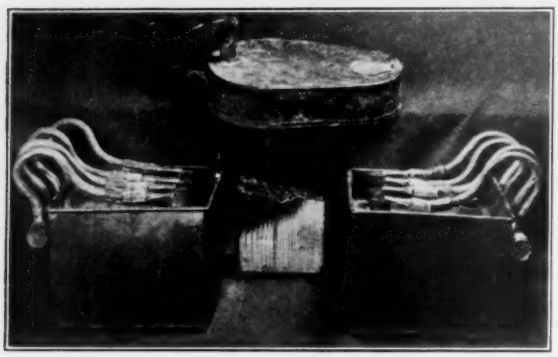


FIG. 4.—Early types of oil lamps used for glassblowing: (*above*) oil blast lamp, (*below*) oil cross fires.

trodes are then attached and the letters or words are evacuated by means of glass diffusion pumps which are also fabricated by the lampworker. After evacuation, the neon or other gases are introduced into the exhausted tube and the tube is sealed. Neon and other gases, which we now use for neon signs, were not available until comparatively recent times when a French scientist, Georges Claude, utilized, with the aid of lampworkers, the principle of Geissler and made the Geissler tube a commercial project.

IV. Christmas Tree Lamps

As Christmas time draws near each year we tell our kiddies that Santa Claus will soon be on his way from the North Pole. We should also say that his assistants, the lampworkers in the Thuringia Hills of Germany, have been working all year making up beautifully colored Christmas tree bulbs and ornaments for the millions of Christmas trees throughout the world. They are made in large quantities in Germany in an old-fashioned village named Lauscha where glass factories, specializing in colors, furnish a satisfactory source of supply for the colored tubing used by the lampworkers.

The production of lamp-blown Christmas tree ornaments can be truly called a home industry. The ornaments are blown in the individual homes of the lampworkers and the entire family joins in making up the production unit. At the present time they are made on gas fires, but originally they were made on lard oil lamps, and the air blast for the fires of the entire family was supplied by means of a large bellows which was foot-operated by the father of the house, who worked at the head of the table or bench. The mother and children (both boys and girls) are arranged along the table. The youngsters clean the glass, pull points on short lengths of tubing, and perform other simple operations. The older children blow simple bulbs, and usually to the mother and some of the children falls the task of silvering, decorating, and inserting the metal clips by means of which the bulbs are hung on the tree.

FIG. 5.—Early type of thermometer of about 1688.

V. Thermometers

A fever thermometer is an insignificant appearing piece of medicine cabinet equipment, yet few people are aware of the skill and care required in the fabrication of these instruments. The

butcher, the baker, the candlestick maker, and practically all commercial manufacturers are dependent upon some form of temperature control involving thermometers, a product of the lampworker's skill. Special shapes and scales are made for the different industries. The meat packer has a skewer type which may be inserted in a ham while it is being cured, an angle-type thermometer is made for acid towers for the chemical manufacturer, and a special form and scale range is made for use in incubators which must be maintained at constant temperatures for the cultivation of microscopic organisms.

FIG. 6.—Glass model of a Radiolarian (*Lithocircus magnificus*), microscopic marine organism occurring in tropical waters. [Courtesy of the American Museum of Natural History, New York, N. Y.]

According to history, credit for the first thermometer is given to Galileo Galilei, a pioneer in the field of science. His thermometer consisted of a glass tube fabricated on an oil lamp and filled with wine. The graduations or scale consisted of glass dots spaced along the tube.

Modern thermometers are still made by hand by lampworkers whose art has progressed to a point where they are indispensable in the routine of our daily life. An idea of the delicacy of the work performed by thermometer makers may be obtained when it is known that they work with tubing having a bore of one-tenth the diameter of a human hair or less. The thermometer industry has gained a secure foothold in the United States, and at the present time there are more than one hundred and thirty thermometer shops, both small and large, in this country.

VI. Hydrometers

Allied with the thermometer makers are the hydrometer makers who fabricate from wafer weight tubing graduated floats used principally for determining the specific gravity of solutions. These are made in various sizes and with scales graduated in accordance with the purpose for which they are intended. They may be used for such diversified purposes as determining the ratio of acid to total solids in citrus fruit or for testing the alcohol solution in your automobile radiator in the winter time.

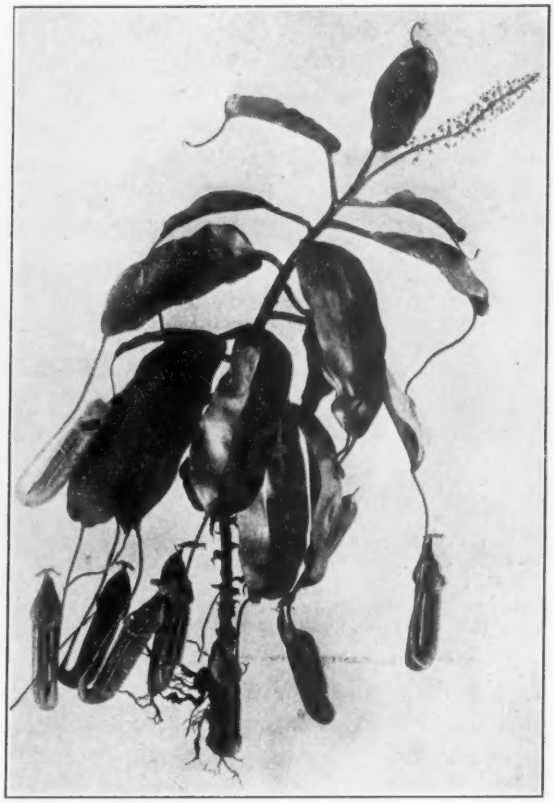


FIG. 7.—Glass model of Malayan pitcher-plant, *Nepenthes maxima Reinw.* (*Nepenthes Curtisii Mast.*). [Courtesy of Botanical Museum, Harvard University.]

VII. Entomological Reproductions

We are all familiar, in a general way, with the insect world about us, but we leave the details

of the life history of worms, bugs, butterflies, and other insects strictly to the entomologist. The entomologist in turn enlists the services of a highly specialized lampworker who constructs from glass and in detail rare specimens of delicate animalcules, their embryo, larvae, and pupae, all of which are anatomically correct. Sometimes the specimens are too minute for observation with the naked eye, and in such instances a jeweler's eyepiece or possibly a microscope is employed for observing the specimen while it is being reproduced in glass. Frequently enlarged drawings are made from microscopic observations and the enlarged museum glass model is fabricated from these drawings. These glass models are made up in natural colors in many instances when the properly colored glass is available. Delicate shades of color are sometimes obtained by the lampworker by blending various colored tubes or rods of glass in the flame of the blast lamp after which the mixture is drawn into rods or blown into bulbs which are subsequently cut into various forms by means of glassblower shears. If the properly colored glass is not procurable for matching the delicate colorings of certain specimens, the model is made up in clear glass and painted in natural colors. The museum glassworker does not, however, confine himself to the duplication of insect specimens exclusively. He also works for the botanist by duplicating in glass specimens of rare plants, grasses, seaweed, and other botanical forms.

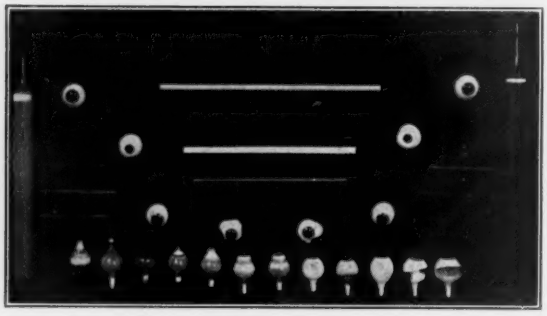


FIG. 8.—The evolution of a glass eye from tubing and rod. [Courtesy of E. & S. Danz, New York, N. Y.]

The rotifer collection made by H. O. Mueller of the American Museum of Natural History in New York, is probably the most notable exhibit of glass models of marine organisms made from microscopic observations, while the Ware collection of plant and flower models at Harvard University containing 160 families of flowering plants, 540 genera, 803 species, and representing more than 3200 analytical magnified details, is undoubtedly the most comprehensive collection of glass models of the flora of many countries. The Ware collection is a memorial to the genius and skill of Leopold Blascha and his son, Rudolph.

VIII. Glass Eyes

"An eye for an eye" might well be adopted as one form of trade insignia for those lampworkers who specialize in the production of glass eyes. The delicately colored glass used for this purpose is made in Lauscha, Germany, from whence comes also the colored tubing and rod used in the manufacture of Christmas tree ornaments.

Glass eyes are fabricated entirely free hand from glass tubing and rod and the original simple colors of tubing and rod are further blended by the eye-maker to secure the necessary delicate shadings of the human eye. Artificial eyes were originally made from copper, and the iris, pupil, and other visible parts were delineated by means of colored enamels painted and fired upon the metal eyeball. These were later replaced by the present-day glass eyes fabricated from glass tubing and rod by skilled lampworkers.

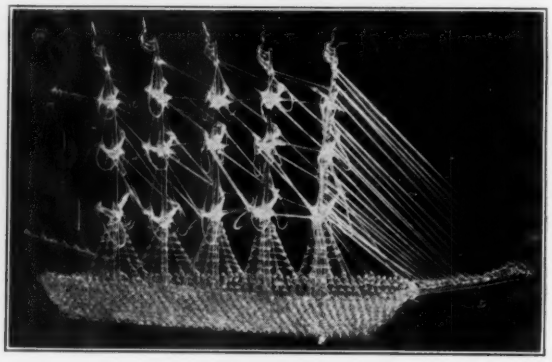


FIG. 9.—Five-masted glass ship about 14 in. long, made entirely from glass rod.

Modern glass eyes are fitted in much the same manner as one purchases a pair of shoes. The shape must conform to the defective eyeball and the coloring must pair with the unaffected eye. It is therefore necessary for the optical dealer to carry a wide assortment of shapes and colors in order that the proper selection can be made. In many instances, however, the purchaser can secure a much better duplication by having the eye made to order, and in such instances, the

purchaser may sit before the eye-maker (much in the same manner one would pose for an oil portrait) while he duplicates in glass an exact replica of the remaining eye. Eye-makers constitute one of the most highly skilled branches of lampworking and many of them have specialized to such an extent that they make only certain colors of eyes.

The manufacture of glass eyes is not confined entirely to the duplication of human eyes. Hunting and fishing trophies, dolls, and many other novelties require glass eyes to make the final product realistic. Consequently, the eye-makers must acquaint themselves with the anatomical variation in the eyes of alligators, fish, pheasants, and other denizens of field and stream.

IX. Artistic Glass

To the average person, perhaps the best known lampworkers are those gentry who travel about the country with carnivals, side shows, county fairs, and other attractions exhibiting, for a nominal admission fee, their skill in artistic glass-blowing. Because there is usually no gas available for their fires, their work is performed on gasoline or oil lamps augmented by an air blast from bellows which are foot-operated. The product of their skill is sold to the audience. With nimble fingers, they will quickly fashion a glass ship, deer, dog, or bird from glass tubing and rod, not to mention such plebian items as cigar or cigarette holders, glass writing pens, or small wine glasses.

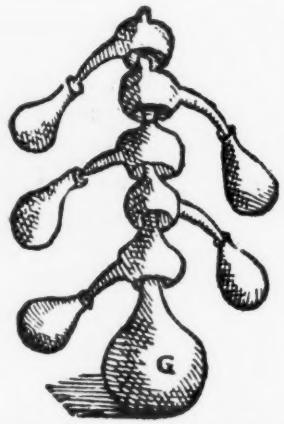


FIG. 10.—Early chemical distilling apparatus made directly from the glass furnace before lampworking was known.

In keeping with modern trends, many of these men (and women) have added dignity to their profession by giving their demonstrations before Chautauqua audiences, service clubs, and schools. There are now also small shops wherein this type of ware is made and subsequently distributed from the novelty counters of department stores.

X. Chemical Apparatus

Modern chemical laboratories are apt to be called upon to solve fanciful and seemingly impossible problems which may be either practical or theoretical. Without the aid of complicated and intricate glass apparatus, many laboratory problems would be impossible of solution. Fortunately, the skill of present-day lampworkers is such that no matter how complicated the apparatus may be, an apparatus maker can usually be found who can construct it.

FIG. 11.—Glass apparatus maker of about 1790.

The early glass-blowers of the period of the alchemists were not familiar with the art of lampworking glass, and the laboratory apparatus which they constructed was made free-hand on crude blowing irons direct from the pot in which the glass was melted.

The first lampworked apparatus, according to early manuscripts, was fabricated on oil lamps, burning "tree oil" as fuel. Construction of lamp-blown laboratory apparatus became an actual industry when Justus von Liebig in 1824

FIG. 12.—"Modern Aladdins," a section of the lamp-room of the Corning Glass Works. [Courtesy of Corning Glass Works, Corning, N. Y.]

was appointed as Professor of Chemistry at the University of Geissen. Von Liebig organized regular laboratory courses to augment his lectures and as other universities followed his example, a demand was created for more refined apparatus than had hitherto been available. As industry gradually recognized the importance of laboratory control and development, new designs of lamp-

blown apparatus were created and, consequently, the foundation of a highly technical industry was laid.

With the introduction in 1917 of Pyrex-brand laboratory glassware made from a low-expansion borosilicate glass, new methods of constructing glass apparatus became possible for the lampworker. With the "softer" lime glasses, it was necessary to handle the glass in the flame quite slowly because of the high expansion of the glass, whereas, with low-expansion glass, the ware can be plunged into an air-gas-oxygen flame without fear of fracture from sudden expansion.

Every industry has its own peculiar problems, and for each problem, whether it be the development of artificial seeds for synthetic raspberry jam or a method of testing the volatility of gasoline and other petroleum products, the final successful result may be dependent upon the skill of an apparatus maker.

Chemical action and dissociation,
Problems that puzzle the chemical nation,
Chemical kitchens whose odor still lingers
Recall the lampworker's spry, nimble fingers.

Corning Glass Works
Corning, New York

A STUDY OF SOME REPRESENTATIVE MUSEUM PIECES*

By Edmund de F. Curtis

Good design rests on the fact that the object is suitable for the purpose for which it was intended. A brick, a machine, or an airplane may all have this element of design. It is not even necessary for the object to be useful; it may have been designed to put a purely esthetic idea into a third dimension, but to be good it must have some purpose and fulfill that purpose.

Then it must have beauty of proportion; that is, its relation of height to width, the point at which it reaches its greatest diameter, must be logical, at least interesting, and, if possible, beautiful.

Beauty of line comes next, that is, the lines connecting the various dimensions of the piece. To me, the two other elements are beauty of color and beauty of texture. I suppose one might add beauty of craftsmanship but that should be taken for granted. Surface decoration comes last of all from the ceramic viewpoint; that is, if the potter is not sufficiently master of his craft to make a piece beautiful and interesting without using surface decoration he must rely on it. And if he does this the decoration should be more than mere space filling.

It is not strange, therefore, that the earlier Chinese monochromes, where the essentials of line, proportion, color, and texture were only enhanced by that mysterious elusive purely ceramic quality imparted by the fire, are preferred by many. Of these monochromes by far the most interesting are the copper reds and of these the finest were undoubtedly made by the brothers Lang. The most interesting of the monochromes were made first during the Sung Period, from 960 A.D. to about 1280 A.D., and the best of the copper reds were made from 1662 to 1722 A.D., when the process was lost. The best example of the Lang Yao (ware made by Lang) red is in the Havemeyer collection in the Metropolitan Museum in New York. One other piece is in the University Museum in Philadelphia and came from the Morgan collection.

Every student of chemistry knows that copper oxide on a borax bead gives a red bead; it is not difficult to make a copper red glaze, but to develop the degree of reduction that will make the deep, rich, full, transparent red that sets the Lang Yao apart from the lesser horse liver, cherry red, and other more common colors is indeed a difficult quest.

The object of an investigation was to get control of the process by which those Chinese master potters worked.

The body materials used were as follows:

Kentucky ball clay D or Champion clay	6 lb.
English ball clay (Enfield brand)	9 lb.
Flint	9 lb.
Potash feldspar	7 lb.
Columbia brand Carolina kaolin	4 lb.
Copper oxide	25 grams
Iron sulfate	5 grams
Oxide of tin	5 grams

The copper is about 0.2 of 1%.

This was made into slip to be cast or thrown. The glaze used was as follows:

* Presented at the Annual Meeting, American Ceramic Society, Cincinnati, Ohio, February, 1934 (Art Division). Received April 9, 1934.

Red lead	4	Soda bicarbonate	3
White lead	4	Boric acid	3
Kaolin	2	Cream tartar	3
Whiting	2	Tin	2
Flint	10		
Borax	10 (calcined)		

No color in the glaze. Sifted but not ground.

The kiln used has already been described.[1] The only differences were the size and the flat plates used for a cover instead of the arch construction. The kiln was 13 inches wide, 24 inches long, 18 inches deep, and was fired with 6 gallons of No. 1 fuel oil to cone 6 flat.

The pots stood in the direct path of the flame and the deposit of soot seemed to be an important factor in developing the color. A No. 9 Kress burner was used with a No. 50 brass nozzle at 30 pounds' pressure, starting from a cold kiln at 2 P.M. At 3 P.M. the kiln would show a slight red color and from then until cone 07 went over at about 4 P.M., the dampers were closed to give it a very strong reducing condition. If the reduction were stopped then and the kiln fired in the usual atmospheric condition until cone 6 was flat, the brilliant color developed. If the reduction was kept up beyond that point, the glaze became muddy from absorbing too much carbon from the smoke.

If too much tin is used in the glaze the color will be liver. High boric acid and whiting in the glaze develops the Flambe-type transmutation colors; rutile gives with the latter a deep rich purple-blue and iron brings back the fine Celadon colors, all under approximately the same firing conditions.

CONESTOGA POTTERY
WAYNE, PA.

[1] (*a*) E. de F. Curtis, "Course in Pottery at the Pennsylvania Museum School of Industrial Art," *Jour. Amer. Ceram. Soc.*, **8** [3], 138–42 (1925). (*b*) "The Small Shop," *Bull. Amer. Ceram. Soc.*, **6** [1], 17–22 (1927).

ACTIVITIES OF THE SOCIETY

Officers of the Industrial Divisions

L. E. Barringer, Charles Harder	Art	R. C. Meeker, H. B. DuBois	Materials and Equipment	J. L. Carruthers, D. A. Moulton	Structural Clay Products
W. N. Harrison, B. J. Sweo	Enamel	H. E. White, R. E. Birch	Refractories	H. D. Callahan, H. E. Davis	Terra Cotta
James Bailey, F. C. Flint	Glass			Edward Schramm, T. A. Klinefelter	White Wares

EDITORIAL

SELFISHNESS PROMPTS PERSONS TO ACTIVE INTEREST IN THIS SOCIETY

A person is an altruist only when he realizes the necessity of investing some of his time, means, and capabilities in activities outside of his personal affairs. To get most quickly and surely the largest returns from these altruistic investments it is necessary to have live-wire social, business, political, educational, religious, and commercial coöperative agencies. A person must share with his fellows the task of providing these coöperative ways and means of acquiring and increasing one's own competency. This is how civilization began. This is how civilization will progress.

Altruism it may be called, yet there is no altruism that is not founded on selfishness. It pays one to aid in providing schools, recreation grounds, libraries, and galleries for his neighbors' children.

It is not altogether altruism when a corporation and a person take membership in the American Ceramic Society. Whether they care to or can read the literature issued by this Society it remains a fact that the selfish interests of each ceramic corporation and each ceramic person are being served by this Society.

So it is with the Meetings. Participation in and contribution to Meeting programs arranged by this Society are an investment in one's own selfish behalf. It pays to be active in the affairs of this Society.

Obviously the larger the membership and richer the Meeting programs and the more informing the literature of this Society, the larger will be the returns to each individual.

Obviously, also, all activities of this Society are by individuals and he who "serves most profits most." There is in this a privilege and an obligation. No red-blooded man wants to live by the efforts of his fellows; he wants to share in the effort required.

It is a privilege to share in the productiveness of this Society both in its making and in its benefits.

Presentation of papers at the Annual Meeting is a personal and a corporate selfish opportunity.

EFFECTIVE PRESENTATION OF PAPERS

Suggestions from The American Chemical Society[1]

Repeated criticism of the papers given at our national meetings has long disturbed those who are responsible for the formulation and presentation of divisional programs. The complaints that authors do not arrange material in clear and logical sequence and that they present their work in a dull and tedious manner are all too frequently justified. The large volume of research reported at each meeting necessitates strict limitation of time assigned to the individual author. The problem is a difficult one, but the group of Divisional Officers believes that conditions can be materially improved if authors will coöperate in observing the following suggestions:

(1) Arrangement of Material: Manuscripts as prepared for publication are seldom suitable for oral presentation. The paper should convey clearly to the hearer (*a*) the purpose of the work, (*b*) the experimental method, (*c*) the results obtained, and (*d*) conclusions. The nature of the material and the time available for presentation will determine the degree of emphasis to be placed on each subdivision. The author should make certain by trial against his watch that the essential points can be adequately presented in the time allotted to the paper.

(2) Statement of Purpose: Orient the audience clearly as to the nature and purpose of the work. A lengthy historical review is generally out of place.

(3) Technic: Describe the experimental method employed so as to indicate the principles involved. Omit details of apparatus or procedure unless there is some particularly novel development. Such data may belong in the published paper but will bore your audience.

(4) Statement of Results: Present the results graphically, preferably with diagrams. Lantern slides are more clearly seen than hand-drawn charts. These slides should be of standard size (3.25 by 4 inches) and should project clearly on the screen. Regardless of who has made the charts or slides, try them from the point of view of the audience before presenting them at the

[1] Reprinted from *Industrial and Engineering Chemistry, News Ed.*, August 20, 1934.

meeting. Do not read tables, a procedure which wastes time and destroys interest, but point out the general trend of the data.

(5) CONCLUSIONS: Summarize the evidence and discuss the importance of the results or conclusions to the particular field of research involved.

(6) MANNER OF PRESENTATION: Do not read from a manuscript verbatim. Talk directly to your audience in a clear, loud voice. Do not face blackboard or screen while speaking. Articulate distinctly.

Many exceptions to, and modifications of, the above suggestions will apply in particular instances. Nevertheless, general adherence to the points brought out will go far in eliminating the valid criticisms which have been aimed at our divisional programs.

Acknowledgment is made to Barnett Cohen of the Society of American Bacteriologists for many of the ideas incorporated in these suggestions.

COMMITTEE A REPORTS NOMINATIONS FOR 1935–1936 SOCIETY OFFICERS[1]

Nominations Committee A reports its nominations for officers of the American Ceramic Society for 1935–1936 as follows: *President:* George Simcoe, Edgar Plastic Kaolin Co., Metuchen, N. J.; *Vice-President:* Perry D. Helser, General Ceramics Co., New York, N. Y.; *Treasurer:* C. Forrest Tefft, Claycraft Co., Columbus, Ohio

—E. WARD TILLOTSON, *Chairman.*

[1] For Committee B nominations see *The Bulletin*, p. 286 (October, 1934).

PACIFIC NORTHWEST SECTION HEARS CORWIN R. MINTON

At a meeting of the Pacific-Northwest Section of the American Ceramic Society held at Seattle, Wash., October 26, 1934, Corwin R. Minton was guest of honor. Modern kilns and the firing of clay products were discussed.

Mr. Minton is the Pacific Coast representative of the Harrop Ceramic Service Co. and ceramic engineer of Gladding, McBean & Co.

He has had considerable and varied experience in the construction of railroad tunnel kilns in all parts of the country as well as an interesting history in ceramic engineering on the Pacific Coast.

—HEWITT WILSON, *Secretary.*

MICHIGAN-NORTHWESTERN OHIO SECTION TO MEET NOVEMBER 23

Plans for the meeting of the Michigan-Northwestern Ohio Section of the American Ceramic Society indicate that the general subject will be enameling. It is hoped to show Ferro Enamel Corporation's sound picture on the making of porcelain enamel frit.—P. W. DAGER, *Secretary.*

PITTSBURGH SECTION HEARS CHARLES D. SPENCER

Charles D. Spencer, of the Glass Technology Laboratory, Incandescent Lamp Works, General Electric Co., Cleveland, Ohio, spoke on "Glass" before the members of the Pittsburgh Section of the American Ceramic Society.

The meeting was held in the Fellows Room of Mellon Institute at 8 P.M., November 13.

ILLINOIS GLASS CONFERENCE ATTENDED BY EIGHTY-SEVEN

Seventy-six out-of-town men representing twelve states attended the Second Conference on Glass Problems held November 2 and 3 at the University of Illinois, Urbana, Ill., under the auspices of the Department of Ceramic Engineering, University of Illinois, and the Chicago Section of the American Ceramic Society.

The geographical distribution of those attending was as follows: Arkansas, 1; Connecticut, 2; Illinois, 23; Indiana, 13; Kentucky, 2; Maryland, 2; Missouri, 5; New Jersey, 1; New York, 5; Ohio, 17; Pennsylvania, 3; West Virginia, 2. Eleven attended from Urbana-Champaign, bringing the total registered on Friday, November 2, to 87.

The following topics were discussed:

(1) "Problems and Perplexities in the Glass Industry," by Wm. M. Clark, General Electric Co., Cleveland, Ohio.

(2) "Heat Balance of a Glass Tank," by A. E. Badger, Urbana, Ill.

(3) "The Relation of Natural Gas to the Glass Industry," by C. F. Henness, Public Service Co. of Northern Ill., Chicago, Ill.

(4) "Combustion of Natural Gas in the Glass Furnace," by James E. McBurney, Owens-Illinois Glass Co., Alton, Ill.

(5) "Fuel Oil *vs.* Producer Gas in Glass Melting," by John Klumpp, Jr., Macbeth-Evans Glass Co., Elwood, Ind.

(6) "Applications of X-Ray Research in the Glass Industry," by G. L. Clark, Urbana, Ill.

(7) "The Use of Cullet," by C. J. Uhrmann, Peltier Glass Co., Ottawa, Ill.

(8) "Practical Tank Operations," by James Arrandale, Thatcher Mfg. Co., Streator, Ill.

(9) "Batch Constituents and Their Effect on the Durability of Glass," by D. D. Burress, Ball Brothers Co., Muncie, Ind.

This is your good ship "Ceramics" and the more corporations and persons you can "get on board" to sail with you down Progress River, the more profit will accrue to each passenger.

WATCH THEM GET ON BOARD!

Year	Paid Members		Total	New Members		Total
	Personal	Corporation		Personal	Corporation	
1933 Whole Year	1184	148	1332	55	2	57
1934 to Aug. 1	1166	159	1325	117	9	126
1934 to Aug. 28	1178	163	1341	122	11	133
1934 to Oct. 1	1202	166	1368	128	14	142
1934 to Nov. 1	1214	169	1383	135	16	151

	Aug. 1	Aug. 28	Oct. 1	Nov. 1
1934 Paid Members	1325	1341	1368	1383
1934 Subscribers	419	426	435	437
Average Current Sales	100	100	100	100
Deferred Payment Members	58	49	49	47
TOTAL CIRCULATION	1902	1916	1952	1967

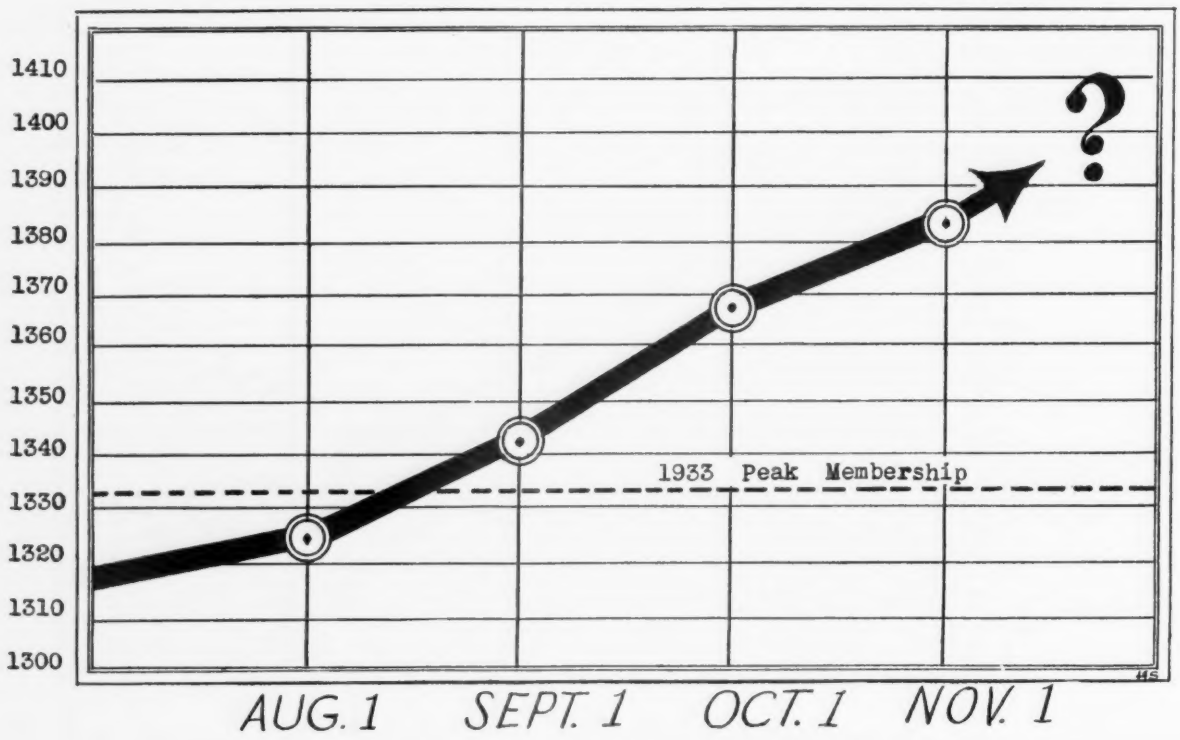
1935 MEMBERSHIP RATES

PERSONAL - - - - $12.50
CORPORATION - $25.00 MINIMUM
Please note that MINIMUM; There is no MAXIMUM LIMITATION!

NEW MEMBERS JOINING DURING NOVEMBER AND DECEMBER:

1. Will be received as for 1935
2. Their dues will be accepted as prepaid
3. Their names will be placed on the mailing list to receive current 1934 publications.

Be sure, therefore, that the personal membership dues paid are $12.50!



NEW MEMBERS

PERSONAL

Blanchard, James R., 766 E. Fifth Ave., Columbus, Ohio; Battelle Memorial Institute.

Couch, E. G., Jr., Box 419, Darlington, S. C.; Darlington County E. R. A.

Heppa, Eric R., 65 Bridge St., Newark, N. J.; Salesman of Pottery Plaster.

Hind, Stanley, 50 Queen's Road, Hartshill, Stoke-on-Trent, England; Ceramic Consultant.

Lester, Walter Ronald, 5612 Stonington Ave., Baltimore, Md.; Chemist, Maryland Glass Corp.

Leun, A. V., 1120 North New St., Bethlehem, Pa.

Levitt, William T., McGregor Instrument Co., Needham, Mass.

Meloche, Villiers W., Chemistry Bldg., University of Wisconsin, Madison, Wis.; Assistant Professor of Chemistry.

Randall, Ruth Hunie, 1052 Ackerman Ave., Syracuse, N. Y.; Instructor, College of Fine Arts, Syracuse University.

CORPORATION

Giesche Fabryka Porcelany S.A., Robert E. Gould (voter), Katowice-Bogucice, Poland.

Will Corporation, H. J. Coleman (voter), Rochester, N. Y.

Membership Workers' Record

PERSONAL

J. D. Sullivan	1	G. J. Barker	1
A. F. Greaves-Walker	1	Office	1
Dewitt D. Irwin	1	CORPORATION	
L. C. Roche	1	R. E. Gould	1
J. C. Hostetter	1	M. E. Holmes	1
J. M. McKinley	1		—
C. H. Parmelee	1	Grand Total	11

ROSTER CHANGES DURING OCTOBER*

Personal

Beinlich, Alfred, Jr., 510 Main St., Rolla Mo. (Camdentown, Mo.)

Cole, Sandford S., Titanium Pigment Co., 105 York St., Brooklyn, N. Y. (Hornell, N. Y.)

Ferguson, Robert F., Montana Apartments, 151 S. Sixth St., Zanesville, Ohio. (Washington, Pa.)

Gould, Kenneth D., 1363 Pennsylvania Ave., Des Moines, Iowa. (Robinson, Ill.)

Greene, Charles F., Alabama Clay Products Co., Bessemer, Ala. (Decatur, Ga.)

Harman, C. G., 1104 W. Springfield, Urbana, Ill. (Effingham, Ill.)

Heath, Chadwick N., 20 Terrace Place, Tuckahoe, N. Y. (Boston, Mass.)

Howat, Walter L., 85 Hopping Ave., Tottenville, N. Y. (Perth Amboy, N. J.)

Hug, William O., 1144 Glenwood Blvd., Schenectady, N. Y. (Canton, Ohio.)

Keith, Wendell P., Federal Seaboard Terra Cotta Corp., South Amboy, N. J. (Perth Amboy, N. J.)

Langenbeck, Karl, 2218 Wyoming Ave., Washington, D. C. (Cincinnati, Ohio.)

McCann, Sidney W., Enamelled Metal Products Corp. (1933) Ltd., Leven, Fife, Scotland. (Schwetzingen, Baden, Germany.)

Planz, Nicholas, Mosaikfabrik-Villeroy & Boch, Mettlach/Saar, Germany. (Bes. Koblenz)

Riebel, E. D. 200 Montrose Rd., Columbus, Ohio. (Crafton, Pa.)

Robson, H. L., Box 56, Lewiston, N. Y. (Niagara Falls, N. Y.)

Rudd, Richard D., 1214 W. Adams St., Phoenix, Ariz. (Marseilles, Ill.)

Spencer-Strong, G. H., 103 W. Monument St., Baltimore, Md. (Columbus, Ohio.)

Sproat, Ira E., Gorham Ave., Westport, Conn. (New York, N. Y.)

Watts, H. L., Oakville Ont., Canada. (Hamilton, Ont.)

* For complete Geographic Roster see *The Bulletin*, pp. 234–54 (Sept., 1934).

COMMITTEE ON CHEMICAL DURABILITY OF GLASS PROGRESS REPORT

The Glass Division of the American Ceramic Society is actively pursuing its work relating to tests for chemical durability of glass. The need for such work and the widespread interest in the subject were amply demonstrated by the Glass Division's recent and very successful meeting at Lake Keuka.

Added stimulus was furnished by the formation of an International Commission for Glass Technology in Venice last year, J. C. Hostetter, of the Corning Glass Works, being the American representative on the Commission. A detailed statement regarding the formation and purpose of the International Commission was published in *The Bulletin*, pp. 205–206 (August, 1934).

The British and German technologists have already tentatively agreed on methods of testing glass for chemical durability and they have asked the Americans to adopt their tentative methods.

Committee on Chemical Durability

A committee on chemical durability of glass was appointed by James Bailey, Chairman of the Glass Division, to handle the matter. Members of the committee are: Donald Sharp, *Chairman*, G. W. Morey, U. E. Bowes, W. F. Brown, F. C. Flint, W. C. Taylor, and J. C. Hostetter, *ex-officio*, representing the International Commission for Glass Technology. The committee outlined their program and a conference was held at the National Bureau of Standards on October 8 to discuss the problems involved and seek the coöperation of the Bureau. This conference was attended by L. J. Briggs, Director, *National Bureau of Standards*, W. Keith McAfee, President, *American Ceramic Society*, Donald Sharp, *Bailey & Sharp Co.*, G. W. Morey, *Geophysical Laboratory*, W. F. Brown, *Libbey-Owens-Ford Glass Co.*, J. C. Hostetter, *Corning Glass Works* and *International Commission for Glass*

Technology, P. H. Bates, G. E. F. Lundell, and A. N. Finn, *National Bureau of Standards*.

It was decided to obtain a large number of samples of sheet glass and hollow glassware from several sources and submit them to the coöperating laboratories for test. The first tests are to be made on crushed or powdered samples of three types of ware according to definitely prescribed methods to see what uniformity in results is obtained. Then the next step in the program will be considered.

The National Bureau of Standards will be custodian of the samples and will distribute them to the coöperating laboratories at such times and in such quantities as are indicated by the chairman of the committee on durability. The samples will be numbered at the Bureau and no reference to their source will be made or given out in any way.

The list of coöperating laboratories is not yet complete, but so far the following institutions have signified their willingness to assist in the work:

Corning Glass Works
Owens-Illinois Glass Co.
Libbey-Owens-Ford Glass Co.
Bailey & Sharp Co., Inc.
National Bureau of Standards
Hazel-Atlas Glass Co.
Hartford-Empire Co.

Other plant and commercial laboratories and also the several interested colleges and universities will be asked to lend their aid to the work.

It is hoped that the plans of the committee will finally result not only in standardizing American methods of testing glass for durability but in helping the work of the International Commission and thus lay the groundwork for a truly international method of making tests for durability and a uniform method of expressing results.

E. C. CLEMENS EMPHASIZES ACCURATE CONTROL OF WARE FIRING[1]

I have read with a great deal of interest your recent articles in *The Bulletin* on thermal history as well as replies and discussions stimulated by them and am prompted to offer a few remarks relative to the importance of controlled thermal history in firing sewer pipe.

Crushing Strength Tests

During the past three years I have made a great many crushing strength tests of sewer pipe by the three-point bearing method and have determined absorption of crushing strength specimens and noted other pertinent details such as age of pipe, appearance, position in kiln, etc. I have just summarized these tests with the view of relating definite properties of the pipe with crushing strength.

My findings in this summary indicate that the absorption and position in the kiln are not uniformly related to the strength from kiln to kiln or for repeated firings of the same kiln with the same kind of ware. Considering all other manufacturing conditions which would affect strength it is my belief that the slightest change in heat treatment of the ware in the various stages of firing greatly influences the final strength.

Variations in Temperature

Our plant uses a typical pyrometer system and we maintain a draft record system but there are often times when kilns of ware mature at temperatures which vary as much as 50°F although apparently cones in the kilns show the same degree of maturity. This is also true of repeated firings of the same kiln using the same schedule and in nearly the same weather conditions.

While most sewer-pipe plants produce ware meeting the standard requirements for strength and absorption, a rather wide variation in these two properties is often found in ware coming from a given plant which variation I believe can be greatly reduced by a practical application of control methods to the manufacture of sewer pipe with particular emphasis on more accurate control of the firing.

—E. C. CLEMENS

CANNELTON SEWER PIPE CO., INC.,
CANNELTON, IND.

[1] Letter to the Editor, Sept. 25, 1934.

CLIFF PARMELEE IS INTERESTED IN CERAMIC WARE FIRING SYMPOSIUM[1]

I have read with interest the published letters on kiln firing in *The Bulletin*. On many points I can not agree with you but your evident intent to "get something started" seems quite worth while.

Ceramic Terminology

It will be very difficult to talk this subject through in the suggested Symposium because we all do not use the same words to describe the same things, and in many cases terms in one ceramic plant mean something entirely different in another plant or in another locality. This is particularly true of ceramic terms describing losses, methods, kiln parts, etc., but is also true of other than purely ceramic terminology, for instance, the words "diffusion combustion." My understanding of these words is that they describe a particular system of burning gas and air in alternate layers or sheets of moving gases which move through a furnace in close relationship with one another but with the same velocity so that very little or no turbulence occurs and the rate of burning is therefore largely dependent on the molecular diffusion of one gas into the other gas. This principle is used by a well-known furnace manufacturer with a great deal of success in certain metallurgical furnaces. On the other hand, it seems to me from reading your letters that you think of these words as describing the principle of combustion commonly known as secondary air which is equally suitable to the burning of solid fuels as well as gaseous fuels.

Diversified Problems

I disagree with you as to the fundamental unity of the

[1] Letter to the Editor, October 19, 1934.

problems involved in heat application to all kinds of ceramic ware. The objectives desired are entirely too varied. As Dr. Morey so well pointed out at the 1934 Meeting the similarity in the problems is largely the development of a glassy bond.[2] Beyond this point variation after variation comes into the problems, making the firing problems and their solutions as diversified as those in the metallurgical field and in heat treating or other metal furnaces.

But the subject need not therefore be considered entirely chaotic or incapable of some degree of orderly and scientific approach. Threading themselves all through the various ceramic firing problems are principles in common to all of them such as heat-transmission laws, combustion principles, and other data and principles of physics and chemistry. It is the peculiar combination of these various principles and data and their relative weights in the various ceramic problems which lead to the extremely diverse nature of the proper solutions. The term "firing" (of any one of the ceramic products) takes into consideration these principles, fundamental data, and their relative weights, with due respect to the product, properties desired in the product, economic factors, etc. It seems to me, therefore, that a Symposium must start with the understanding of the extremely diverse nature of the problems and their proper solutions or we get nowhere through attempting generalizations where these are not possible. I would be glad to hear on this point from others. The few people I have contacted on this Symposium, who were well qualified to express their ideas, felt very much as I do about it.

Division of the Problem

If it could be arranged to have the field divided into proper divisions and details of problems and their solutions presented for each particular division, and in connection with this some further expositions of the fundamental principles existing in them all, I believe you might get somewhere. One common cause for some of the "darkness" in the field of ceramic firing is the dearth of information on fundamental properties of the products. It has only been very lately that specific heat data are available with any degree of accuracy on some of the products both before and after firing and also during the course of the firing operation. Still less information is available on the coefficient of thermal transmission before, during, and after the firing operation. Reversible and irreversible volume changes are known on some of the important constituents of ceramic bodies, but the particular volume changes occuring in any one given product are in many cases still lacking. Modulus of rupture figures are available in the cold for many fired ceramic products, particularly structural clay and refractory products, but rarely are these figures available of this modulus at any temperature desired during its ceramic firing. Reaction rates of various chemical changes at elevated temperatures are many times still a matter of pure speculation. These illustrations could be added to almost indefinitely, but are merely mentioned to show the difficulty of making the proper scientific approach to any one particular firing problem, let alone a generalized procedure for all products.

Collection of Data

I therefore suggest that a worthy aim of such a Symposium might be to call attention to the lack of this data, arrange for a committee to collect and publish all existing data, and to encourage the acquisition and publishing from time to time of that which is still lacking, both on basic ceramic materials and particular combinations of these materials which exist in many of the important specific products.—C. H. PARMELEE

ONONDAGA POTTERY CO.,
SYRACUSE, N. Y.

[2] "Glass: the bond in ceramics," *Jour. Amer. Ceram. Soc.*, **17** [6], 145–55 (1934).

ARTHUR P. WATTS DISCUSSES CERAMIC WARE FIRING[1]

I have read with much interest the editorials and letters which have appeared in *The Bulletin* on the subject of ceramic ware firing. I do not believe there can be any argument about the necessity for even and uniform heat treatment for every type of ceramic product, whether it be sewer pipe or the finest of tableware, if that product is to be uniformly high in quality. The difficulty is and always has been to obtain furnaces and furnace equipment which would afford such treatment, yet not injure the ware in other respects, such as ultimate appearance. If it were not for this factor we would probably have only one fuel in common use in the ceramic industry instead of a variety of fuels.

Strength versus Appearance

It is perhaps unfortunate for the ceramic manufacturer that his products are sold not only on the basis of strength (which is perhaps the one best reason for a uniform thermal history for each piece) but also in most cases on the basis of appearance, and it is this requirement which very often makes it impossible to afford each piece the same heat treatment. For example, if coal or oil is used in a round periodic ceramic kiln, with the ware enclosed in saggers, it is undoubtedly possible to obtain a more uniform temperature throughout the kiln by means of a long flame. However, a long flame generally means that insufficient air for complete combustion is present at the fire pit or burner nozzle and therefore if complete combustion is to be had the combustible gases must unite with secondary air while in their course of travel through the kiln. These gases in the process of combustion surround the saggers and filter in and around the ware. The probability that such an atmosphere is reducing in its effect is great and for this reason a long flame (which would undoubtedly afford the best heat treatment as far as uniformity goes) can not be used because of the injurious effect upon the appearance of the ware. It is probably true, however, that a stagnant atmosphere, slightly reducing, is far less injurious than the same atmosphere surrounding the

[1] Letter to the Editor, received September, 1934.

ware in a state of turbulence, otherwise, why use saggers at all? Research work carried on by the writer tended to prove this point.

Furnace Atmospheres

The writer has definitely proved that oxidizing atmospheres composed of normal products of combustion of gas have no harmful effects upon glazed ware when surrounding the ware in a state of quiescence or when they do not come in contact with the ware while in the actual process of combustion.

I do not believe that the firing problems of the ceramic industry will be solved by merely obtaining uniform heat treatment for each piece and neglecting the consideration of furnace atmospheres when so doing. Perhaps the composition of the furnace atmosphere is not so important as the speed and volume of the gases in contact with the ware. That is a subject which to my knowledge has never been adequately gone into and which might be well worth while.—ARTHUR P. WATTS

A C SPARK PLUG CO.,
FLINT, MICH.

THERMAL HISTORY OF IOWA CLAYS PROJECT ESTABLISHED

Dean Agg of Iowa State College, Ames, Iowa, has given a fellowship and money from the Engineering Experiment Station to start the Thermal History of Iowa Clays project requested by H. R. Straight.[1]

Paul E. Cox, Head, Department of Ceramic Engineering, Iowa State College, has appointed Frank B. Hodgdon to the fellowship. Mr. Hodgdon, a graduate of Iowa State College, has an M.S. from Massachusetts Institute of Technology under Professor Norton.

The American Ceramic Society's discussions on ceramic ware firing helped to stimulate this action in Iowa. Ceramists in other states should profit from similar investigations.

[1] *The Bulletin*, p. 232 (Sept., 1934); p. 280 (Oct., 1934).

CERAMIC ENGINEERING SHOULD HAVE RECOGNITION AS PROFESSIONAL[1]

Consulting ceramic engineers, some of whom have practiced many years, design and erect plants, design and install equipment, institute processes and develop their control, prospect, survey, and prove mineral and clay deposits, and develop and render on time retainers technical supervision of production of new products.

Constructions by Ceramic Engineers

Ceramic engineers have developed building construction features such as reinforced brick masonry, waterproof terra cotta joints, interlocking tile, load-bearing floor tile construction, acoustic and heat and sound insulating tile, all of which have involved engineering studies and the development of engineering data.

For engineering construction such as sewers, pavements, bridges, and electric conduits, our ceramic engineers have developed and have continually improved ceramic products, as well as tests and specifications.

For engineering utilities, ceramic engineers have designed shapes, compositions, and processes for porcelain and glass insulators for the most severe requirements. In these developments they have employed all sorts of engineering tests and have devised with consumers the specifications and standards for every specific requirement.

Industrial Developments

For industrial enterprises which use heating furnaces, ceramic engineers have developed refractory compositions and shapes which meet increasingly severe requirements. There are no more exacting engineering problems than those of refractories for powdered coal, oil, gas, and electric high-temperature furnaces, especially those in which slags and molten metals are involved.

For domestic and hygienic purposes, ceramic engineers have devised and produced, to exacting specifications, all sorts of sanitary, cooking, and refrigeration ware.

Scientific Contributions

For science and scientific instruments, ceramic engineers have developed the glasses and methods of their working for all sorts of optical purposes including the 200-inch Corning Glass Works disk, telescopes, microscopes, and range finders. This task was suddenly thrust upon us during the war. It involved production methods and conditions with which we were not familiar.

The automobile and airplane brought up spark plug and safety glass problems, the severest of which ceramic engineers have successfully solved.

Tools for Machinery

For machinery of all sorts, and for rotary parts from the most delicate to the heaviest of transportation wheels, abrasive wheels, made by ceramic engineers, have been essential tools, the production of which has involved chemical and physical science and technology of the highest order.

Summarizing, it appears that there is no engineering development which does not involve the work of ceramic engineers. The ceramic engineer must be fully versed in the engineering undertakings in which his product is employed.

The successful ceramic engineer must be well grounded in the chemistry and physics of his production materials and processes, and in the engineering concepts of the use of his product.

University Recognition of Ceramic Engineering

The first ceramic engineering school was established at Ohio State University in 1895. Since then the University

[1] Letter to H. H. Horner, University of the State of New York, State Education Dept., Albany, N. Y., October 12, 1934.

of Illinois, Rutgers University, Iowa State College, University of Washington, Alfred University, Georgia School of Technology, Massachusetts Institute of Technology, North Carolina State College, West Virginia University, University of Alabama, and Pennsylvania State College have instituted ceramic engineering degree courses.

Ceramic engineering, as a profession, had broad recognition four decades old. You may imagine our surprise, therefore, that for purposes of registration of professional engineers, the eligibility of ceramic engineers was not at once recognized.

I have carefully studied your Handbook No. 36, and the laws and application forms adopted by Ohio without finding one reason for questioning the eligibility of ceramic engineers as such rather than as chemical or mining engineers.

H. H. Horner Replies[2]

We have no lack of appreciation of the importance of ceramic engineering and no lack of interest in it. The sole question for us is whether or not the courses in ceramic engineering, as at present organized, generally qualify prospective candidates for admission to our licensing examination for professional engineers.—H. H. HORNER

Ohio Recognizes Ceramic Engineering[3]

I was informed several days ago by Perry T. Ford, Secretary of the Ohio Board of Examiners, that ceramic engineering is one of the nine fundamental branches of engineering which they now recognize.

Some months ago a hearing was held by the Board at which A. S. Watts, W. E. Cramer, and I were present. We stated the reasons why ceramic engineering should be included. Since then the board has included ceramic engineering.

The wording in the Ohio Law in defining a Professional Engineer is practically identical with that quoted by H. H. Horner in his letter to you. (See *The Bulletin*, p. 282 (October, 1934).—J. L. CARRUTHERS

Rule Six as Amended[4]

Rule VI—Branches of Professional Engineering

The board recognizes for the purpose of registration nine fundamental branches of engineering, namely, Civil, Mechanical, Electrical, Mining, Chemical, Metallurgical, Structural, Ceramic, and Industrial. An applicant for license as "Professional Engineer," in order to be accepted and licensed, shall qualify under one or more of the above classifications. The board reserves the right to issue certificates under special classifications in branches not enumerated above whenever deemed advisable and expedient to do so.

[2] October 22, 1934.

[3] Dept. Ceramic Engineering, Ohio State University, October 26, 1934.

[4] From Rules and Regulations of the State Board of Registration for Professional Engineers and Surveyors, State of Ohio, p. 20.

RATE PHENOMENA IN REFRACTORY SYSTEMS SYMPOSIUM

To Be Presented by Refractories Division, Annual Meeting, Next February

A great deal of attention has been given to the determination of the equilibrium state in refractory systems as witnessed by the excellent compilation by Hall and Insley in the October, 1933, *Journal*. The subject of rates, that is, the problem of what factors govern the velocity of change in refractory materials, has been rather neglected. It is the object of this symposium to focus attention on this question with the hope that an analysis of the factors concerned will lead to better understanding of refractory behavior.

The subject of rates may be classified under rates of (1) inversion or polymorphic changes, (2) crystallization and fusion, (3) recrystallization, grain growth, and sintering, (4) vaporization, (5) reaction, (6) diffusion, and (7) flow of gas, liquid, and glass.

Any characteristic of a refractory in service, such as slow volume change, slag attack, or insulating quality may be described in terms of one or more of the items listed.—NELSON W. TAYLOR

NOTES AND NEWS

UNIVERSITY OF WASHINGTON CERAMICS HAS THE WELL-KNOWN HEWITT WILSON PUSH

The three men who were graduated last year from the ceramic engineering division of the College of Mines have good positions. Gordon Adderson was placed on the staff of Gladding, McBean & Co. and has been engaged on the construction of the first railroad tunnel kiln to be erected in the Pacific Northwest. George Middleton, with William Lewis and LeRoy Backus, has just opened the "Potlatch Pottery" in Seattle for the manufacture of ceramic novelties. Kenneth Skinner was placed in charge of the research laboratory of the Universal Gypsum and Lime Co. at York, Pa.

Montana Will Emphasize Ceramics

Wurth W. Kriegel, graduate of 1932, will take charge of a study of the clays and other ceramic materials of Montana at the Montana State School of Mines at Butte and also initiate courses in ceramics as the beginning of a department of ceramic engineering.

Fred M. Kettenring, '31, has recently entered the technical sales department of the Concrete Pipe Co., Seattle. Carl E. Curtis, '31, is a research fellow in ceramics at the Engineering Experiment Station, Ohio State University. Frank Zvanut, '32, starts his second year as ceramic

engineering instructor in the State School of Mines at Rolla, Mo. Another position is awaiting a ceramic engineer for research and plant work in eastern Washington.

The recent interest of the U. S. Government in the housing situation and the revival of construction will stimulate the heavy clay products division of ceramic engineering. In coöperation with the Northwest Experiment Station, U. S. Bureau of Mines, the ceramic division has been studying the interesting nonmetallic minerals of the Northwest.

Bulletin No. 76 of the Engineering Experiment Station entitled "Kaolins and China Clays of the Pacific Northwest," was published this summer. Albert Couch, ceramic engineer from the University of North Carolina, and Joseph Pask, ceramic engineer from the University of Illinois, are continuing the study on the silica sands and the soapstone deposits of the state. At present these nonmetallic materials are shipped to the Northwest from Europe and the east coast.

ORTON FOUNDATION ESTABLISHES TWO FELLOWSHIPS

The Orton Foundation has established two fellowships at Ohio State University. One is held by C. J. Koenig who is working for his doctorate. He is studying the fluxes which can be used between cones 010 and 3 to eliminate iron from the composition.

Robert F. Rea, who holds the second fellowship, is studying the whole problem of frozen cones. He is also studying for his doctor's degree. The freezing of ceramic bodies during firing and the relation of properties to freezing is to be investigated.

In the research department of the cone plant, M. C. Shaw has developed an improved binder for cones. The binder formerly used had been responsible for most of the crooked cones. A new method of manufacture has been worked out whereby the cones are made automatically and are not touched until dry.

O. Hommel Company Adds W. J. Baldwin to Fellowship Staff

William J. Baldwin has been appointed to the O. Hommel Company Industrial Fellowship at Mellon Institute according to the Institute's director, Edward R. Weidlein.

Mr. Baldwin, a ceramic chemist, graduated from the University of Buffalo in 1926. His experience with the American Radiator Co. at Buffalo during the past eight years has been in analysis of raw materials and the use of various chemicals in frit making. As foreman of the mill room and smelting department there he also gained practical experience in wet-process enameling with both steel and cast-iron enamels.

In his new position, Mr. Baldwin will devote most of his time to investigations in plants.

Ohio State Experiment Station Has Six Ceramic Fellowships

There are six fellowship men in the Engineering Experiment Station, Ohio State University, working for advanced credit leading to the degree of Doctor of Philosophy. These, with the projects on which they are working, are as follows:

A. G. Allison, Bonds for Mullite Refractories.
C. E. Curtis, Micro Study of the Effect of Pressure on Vitrification.
J. O. Everhart, A Micro Study of Vitrification Versus Time in Firing Refractories.
C. J. Koenig, Fluxes for Cone Mixes.
R. F. Rea, A Micro Study of the Freezing of Ceramic Bodies.
H. Zane Schofield, The Noncrazing Wall Tile Glazes.

UNIVERSITY OF SOUTHERN CALIFORNIA OFFERS NEW CERAMIC COURSES

Sponsored by the California Section of the American Ceramic Society, new courses in ceramics under Glen Lukens, instructor in ceramics, and Thomas S. Curtis, instructor in ceramic technology, are offered at the University of Southern California for the present school year.

The close relationship between these ceramic courses and the well-organized professional departments of architecture, sculpture, and design at this university offer the ceramic student unique advantages.

Well-lighted studios and laboratories with individual benches and complete equipment including two kilns, potters' wheels (both electric and foot power), a glaze grinding mill, hand tools, and facilities for the studying of glaze formulas and their compounding and application in ceramic decoration are now available.

Modern technical and industrial processes, with design and craftsmanship emphasized, are thoroughly studied in this curriculum. From the first, students are taught to work directly with clay.

The 1934–1935 courses in the principles of ceramic technology will include basic procedures upon which ceramic art and technique are founded. Among these are the ceramic structure of matter, control of the properties of the ceramic body by its physical composition, elements of slip casting and hand pressing, and the principles of drying, glazing, and firing.[1]

[1]For a complete outline of Basic Principles of Ceramic Technology see *The Bulletin*, pp. 207–208 (August, 1934).

Keramos Committees Announced

Keramos, the national professional ceramic engineering fraternity, announces the appointment of the following committees:

Committee on Graduate Placement: A. H. Fessler, A. C. Spark Plug Co., *Chairman;* W. L. Fabianic, Owens-Illinois Glass Co.; R. E. Birch, Harbison-Walker Refractories Co.; H. G. Wolfram, Porcelain Enamel & Manufacturing Co.

Committee on Ceramic Education: S. R. Scholes, New York State College of Ceramics, *Chairman;* E. H. Shands, Detroit Vapor Stove Co.; W. C. Rueckel, Ohio State University; Robert Sherwood, Smith and Stone, Ltd.

Committee on Research: J. L. Carruthers, Ohio State University; C. R. Amberg, New York State College of Ceramics; A. McKinley Greaves-Walker, Libbey-Owens-Ford Glass Co., Harry Thiemecke, Homer Laughlin China Co.; A. I. Andrews, University of Illinois, R. S. Bradley, A. P. Green Fire Brick Co.

Committee on Publicity: A. F. Greaves-Walker, University of North Carolina, *Chairman.*

—F. L. Steinhoff, *President.*

A. I. Andrews Prepares Book on Porcelain Enamels

A. I. Andrews, of the University of Illinois, has prepared a book on porcelain enamels which should be ready for distribution before the first of the year.

Its thirteen chapters and appendix include all of the different phases of enameling from the raw materials to the properties and tests of the finished product.

The history of enameling, fundamental considerations such as phase relations, high-temperature chemistry, properties of enamel glasses, opacity and color, raw materials, enamel compositions for sheet-iron enamels, dry process and wet process cast-iron enamels, special enamels and jewelry enamels, and the effects of the different raw materials and constituents on the properties of the enamels are discussed. Methods of calculating compositions, considerations involved in the enamel metal, and the preparation of the metal surface by cleaning, pickling, and blasting are described. Smelting and milling are fully discussed. The theory, control, and practice of application are explained in detail.

The development of modern enameling furnaces, the chemistry and physics of firing, and the properties of enamels as glasses and as finished ware are reviewed. Methods of testing are given in detail. Defects are discussed from the standpoint of causes, identification, and correction.

The book will contain 124 figures and 58 tables.

NECROLOGY

James F. Sinclair

James F. Sinclair, General Manager of the Jeffery-Dewitt Insulator Company, died of a heart attack at Huntington, W. Va., on October 23. He had been manager of this company since 1922 but had delegated most of his duties to others during the last two years on account of his health. He leaves a widow and three children and will be missed by many friends in the ceramic industry.

Mr. Sinclair acted as voter for the Jeffery-Dewitt Insulator Company in the affairs of this Society for eight years.—Charles E. Lyons.

THE DRESSLER TUNNEL KILN'S EARLY HISTORY

By Charles J. Kirk[1]

The Dressler tunnel kiln was designed by a Swiss engineer. The first one was installed in a tile factory in Geneva, Switzerland. This kiln was designed with a twenty-inch circular fireclay flue on each side of the cars. This did not work because the heat was concentrated on the center of the cars. Consequently the present style of flues was designed. These are triangular-shaped and made of hollow tile. They form flues around the chamber with openings at the bottom and top to concentrate heat. This new flue design solved the trouble.

Dressler was an artist who designed tile fireplaces and mantels for architects. He had trouble in getting tile of the proper shade, as those fired around the bags in the old style upright kilns, where they were subject to high heat, were of an entirely different color from those fired in the center of the kiln. Having heard of the success of the Swiss kiln, he induced the Barret Brothers, large manufacturers of tile in England, to install one of these kilns. It was such a great success both in fuel saving and in producing uniform colored tile that he joined with Swiss engineers and formed the Dressler Tunnel Kiln Co. of England to build the kilns.

Having read a report of the kiln in a trade paper, we wrote to inquire if this type of kiln could be adapted to firing sanitary ware. The engineers assured us it could. They were using fuel gas made from coke and the savings in fuel and the uniform product were wonderful.

The Swiss engineer who had designed the kiln had been killed. He had patented a gas regulator to control the flow of fuel gas from the generator to the kiln and had it in operation on the kiln in Geneva. He arranged to have a French engineer, a German engineer, and Bernard Moore of England visit the Geneva plant and make a report on the operation of the valve. When they arrived, the plant

[1] Kirk Engineering Corp., New Castle, Pa. Received October, 1934.

had been shut down to make some changes on the valve. The engineers were asked to visit the plant while it was starting up. Mr. Moore refused to go, saying that he was there to make a report on the valve, and would wait until it was in full operation before inspecting it. He took a boat trip around the lake. After he had been out about half an hour, he heard a terrific explosion in the city. When he returned, he found when they attempted to light the kiln, the gas which filled the sewers exploded and killed the Swiss engineer and the German and French engineers. This left Mr. Dressler in sole charge of the English company, who made a contract with us to erect a tunnel kiln at the plant of the Universal Sanitary Manufacturing Co. at New Castle, Pa.

When the kiln was started a large percentage of the ware came out dunted. By pushing the cars very slowly this trouble was overcome but the output was reduced so much that it did not pay. An addition of about eighty feet to the length of the kiln solved all the problems. About 95% of the ware was A quality, and natural gas was used for fuel. The old upright kilns required about 350,000 cubic feet of gas a day. The same amount of ware was fired in the tunnel kiln with 50,000 cubic feet per day. This fuel saving was so remarkable that we took over the rights for the United States and formed the American Dressler Tunnel Kiln Co.

The cars on the Dressler kiln were carried on roller bearings. A two-inch channel iron was riveted on the bottom of the car. The rollers put up in sections of six each were made from two-inch round tool steel turned down to one-half inch round at each end so that the flanges of the channel rested on them. We found that a small flanged wheel to run on light T-rails was better adapted to heavy loads, and all kiln cars are now equipped in that way.

We took an order from the American Sheet and Tin Plate Co. to build a continuous annealing oven. It was a huge affair and took about one year to construct. This was in 1916 and before it was finished, the prices of labor and material had advanced so that we had a big loss on the contract.

We also took a contract from the Jones & Laughlin Steel Co. to build a Dressler-type annealing oven for black plate. We thought we had made enough allowance for advance in prices, but they continued to advance so rapidly that we had a large loss on this contract.

In making a search in the Patent Office for any patents that would conflict with those on the Dressler kiln, I found one granted to a common brick manufacturer in Chicago. It covered a twin tunnel kiln, the brick to be loaded on steel railroad cars with fireclay tops pushed in from the opposite end of the kiln so that the cold cars coming in would meet the hot cars coming out, and the brick would be fired and shipped direct to the consumer without being handled. As there was no provision made for circulating the heat, it was not a success.

We conceived the idea of building a twin tunnel kiln with a wall in the center and with openings at top and bottom so that the heat would rise from the hot car and drop down through the cold ware on the cold car coming in the opposite direction. I applied for and was granted a patent on this construction. I then sold my stock in the American Dressler Tunnel Kiln Company and started to promote the twin tunnel kiln.

MINERALS YEARBOOK OF THE UNITED STATES BUREAU OF MINES ANNOUNCED

The Minerals Yearbook, 1934, has been announced by the United States Bureau of Mines. Only a limited number of copies is available. As in the Minerals Yearbook of 1932–33, the new volume supplements the statistical information and economic discussions of mining printed in various former publications including Mineral Resources of the United States, which was issued annually for over fifty years.

Mining engineers and executives will find the Minerals Yearbook an indispensable tool and will appreciate the convenience of having the data condensed into one volume of 1154 pages and 72 chapters. All statistical material is presented in concise summary tables and 106 graphs illustrate the principal trends in various branches of the mineral industry. A complete index adds to the reference value of the volume.

Copies of the Yearbook in blue cloth may be purchased from the Superintendent of Documents, Govt. Printing Office, Washington, D. C., for $1.75, but no money derived from sale of its publications reverts to the Bureau.

Applied Mechanics Quarterly Announced

A *Journal of Applied Mechanics* will be published quarterly beginning 1935 by the American Society of Mechanical Engineers.

Papers presented before the Applied Mechanics Division of the Society, reviews of pertinent literature, notes on important developments, and other papers will be printed in this quarterly.

An editorial board of specialists on elasticity, plasticity, strength of materials, vibration, aerodynamics, thermodynamics, film lubrication, and electro-mechanics will be appointed.

The *Journal* will be sold to nonmembers at $5.00 per year.

Lowered Production and Higher Production Costs Endanger Ceramic and Allied Industries

According to tabulations of the U. S. Department of Commerce census of manufacturers for 1933 released October 15, potteries employed 12.5% fewer workers during 1933 than in 1931, but the decrease in value of their total output during this same comparative period was more than 37%.

In glass production the value of the manufactured products decreased 11.2% for 1933, and wage-earner employment increased 2.4% in the same period.

The conclusion to be drawn from impartial government data such as this is obvious.

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The Vitro Mfg. Co.

Clay (Electrical, Porcelain)
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
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Spinks Clay Co., H. C.
The Vitro Mfg. Co.

Clay (Enamel)
Ceramic Color & Chemical Mfg. Co.
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Clay (German Vallendar)
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Clay (Potters)
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Clay (Sagger)
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Spinks Clay Co., H. C.

Clay (Wad)
Potters Supply Co.
Spinks Clay Co., H. C.

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The Vitro Mfg. Co.

Crucibles (Filter, Melting, Ignition)
Norton Co.
Potters Supply Co.

Crystolon (Refractory Products)
Norton Co.

D

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Drying Machinery
Ferro Enamel Corp.

E

Enameling Equipment (Complete)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

Enameling Furnaces
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Norton Co.
Porcelain Enamel & Mfg. Co.

Enameling Iron (Sheet)
American Rolling Mill Co.

Enameling Muffles
Carborundum Co. (*Carbofrax*)
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

Exolon (Refractory Products)
The Exolon Co.

F

Feldspar
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Norton Co.

BUYERS' GUIDE (continued)

Flint
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Flint Pebbles
Ferro Enamel Corp.
The Hommel Co., O., Inc.

Floors (Non-Slip)
Norton Co.

French Flint
Paper Makers Importing Co.

Frit
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Furnace
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

G

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Grinding Wheels
Norton Co. (*Alundum Crystolon*)

H

Hearths
Carborundum Co.
(*Carbofrax* heat treating)
Norton Co. (*Crystolon*)

Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.

I

Iron (Enameling)
American Rolling Mill Co.

Iron Oxide
Drakenfeld & Co., B. F.

K

Kaolin
Ceramic Color & Chemical Mfg. Co.
Edgar Brothers Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
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Kilns China, (Decorating)
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.

Kryolith
The Hommel Co., O., I nc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

L

Leeds (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.

Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Norton Co.

M

Magnesia (Sintered, Calcined)
The Exolon Co.
Norton Co.

Magnesite
Ceramic Color & Chemical Mfg. Co.
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Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Manganese
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Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Metals (Porcelain Enameling)
American Rolling Mill Co.

Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Muffles (Furnace)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
Norton Co.

Mullite (Artificial)
The Exolon Co.

Muriatic Acid
The Hommel Co., O., Inc.

N

Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

O

Opacifiers
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Oxides
Ceramic Color & Chemical Mfg. Co.
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Drakenfeld & Co., B. F.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

P

Pins
Potters Supply Co.

Porcelain Enameling Service (Practical)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co
The Vitro Mfg. Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
McDanel Refractory Porcelain Co.

R

Refractories
Carborundum Co.
The Exolon Co.
Norton Co.

Refractory Materials
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The Exolon Co.
Norton Co.
Titanium Alloy Mfg. Co.

Rutile
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Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

S

Saggers
Carborundum Co.
Norton Co.
Potters Supply Co.

Selenite of Sodium
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.

Silica (Fused)
The Exolon Co.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
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Norton Co.

Silicon Carbide Firesand
The Exolon Co.

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Norton Co.

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The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.

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The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sodium Antimonate
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Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Sodium Fluoride
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The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Spar
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The Hommel Co., O., Inc.
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The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Spurs
Potters Supply Co.

Stilts
Potters Supply Co.

Sulphuric Acid
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.

BUYERS' GUIDE (continued)

T

Talc
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp
The Hommel Co., O., Inc.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Norton Co.

Tile (Wall)
Ferro Enamel Corp.
The Hommel Co., O., Inc.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Roessler & Hasslacher Chemical Co.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
The Hommel Co., O., Inc.
The Roessler & Hasslacher Chemical Co.
Titanium Alloy Mfg Co
The Vitro Mfg. Co.

Tubes (Insulating)
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
McDanel Refractory Porcelain Co.
Norton Co.

W

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Ferro Enamel Corp.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Drakenfeld & Co., B. F.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Roessler & Hasslacher Chemical Co.

Z

Zirconia
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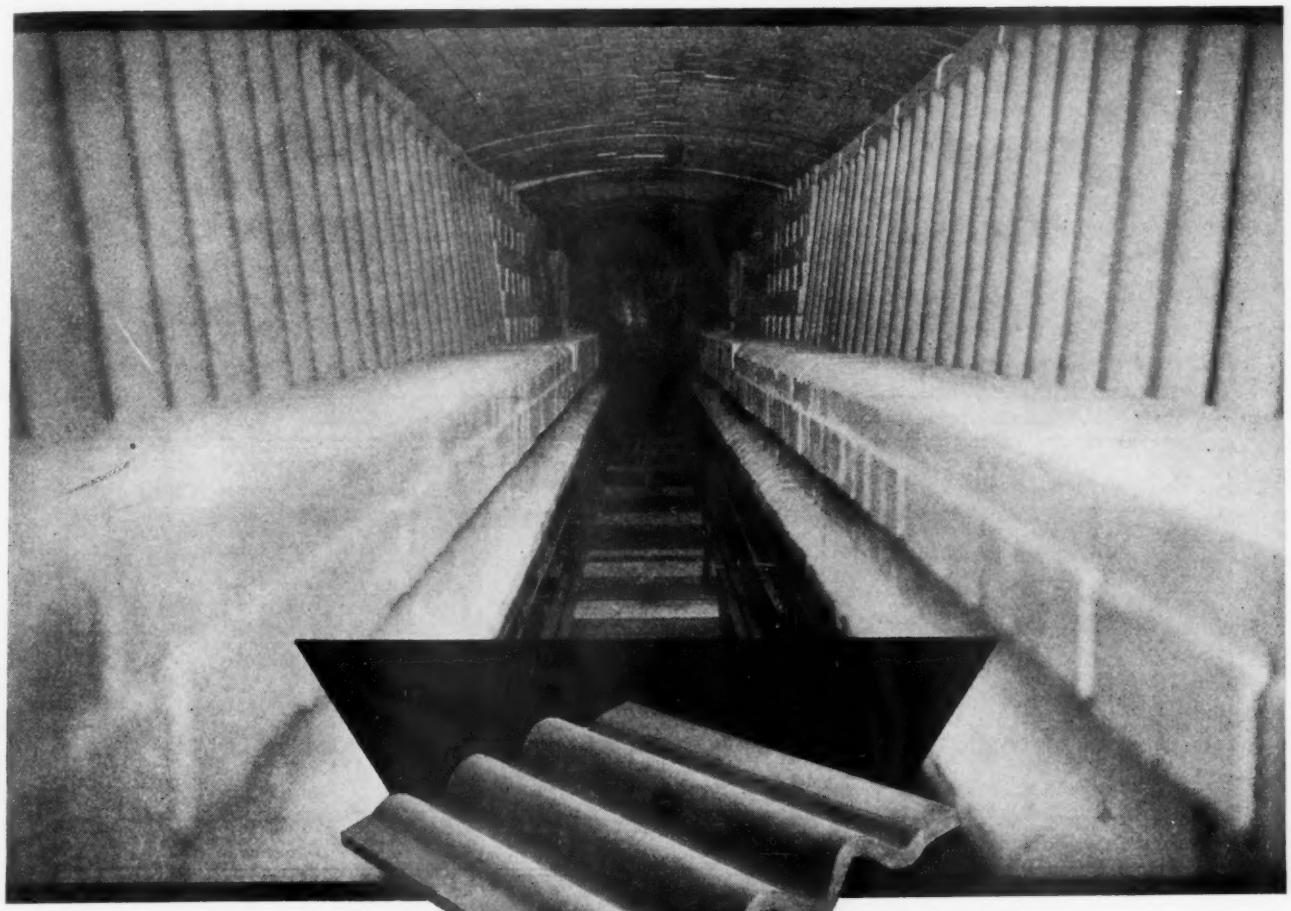

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Established 1864

The Chas. Taylor Sons Company

Manufacturers of Fire Brick

FACTORIES
CINCINNATI, OHIO.
TAYLOR, KENTUCKY.

ARTHUR P. TAYLOR, PRESIDENT
CHARLES H. TAYLOR, VICE PRESIDENT
M. C. BOOZE, VICE PRESIDENT
CLIFFORD R. TAYLOR, SECRETARY

P. B. SILLIMANITE SUPER-REFRACTORIES

CINCINNATI, OHIO,

August 7, 1934

Bethlehem Steel Co.,
Bethlehem, Pa.

RE: YOUR LETTER JULY 24 - SH:AMC.

Gentlemen:

With regard to the 88-80 Muller Tires which we have purchased from you, we are unable to give you a definite figure on the life as against ordinary tires previously used, as the original tire purchased from you about two years ago is still in service and appears to be good for at least another year. When this tire was first put in use, an ordinary tire was installed on the second Muller and was sufficiently worn at the end of about six months that it had to be removed.

We do not remove the metallic iron from our Sillimanite as we have been unable to find a satisfactory method for separating. However, we know that the amount of iron introduced in the ground P. B. SILLIMANITE has been reduced by a noticeable amount. We are more interested in your tires from the standpoint of the amount of metallic iron introduced into the ground Sillimanite than because of the length of life, although the reduced wear of course results in a saving for us.

We do not measure the power consumed by our grinding equipment and cannot tell you whether or not your tires have had an influence in that direction. We do feel, however, that the capacity of our dry pan is increased because of the fact that the face of the tires remains comparatively flat and consequently grinds more efficiently.

We are very well pleased with the service rendered by your tires and expect to use them on other pans employed for grinding fire clays, etc.

Yours truly,

THE CHAS. TAYLOR SONS CO.

M. C. Booze

Vice-President

MCBooze:F

Castings of BETHLEHEM 88-80 ... Resist Abrasion

BETHLEHEM STEEL COMPANY, General Offices: BETHLEHEM, PA.

District Offices: Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, Washington, Wilkes-Barre, York. Pacific Coast Distributor: Pacific Coast Steel Corporation, San Francisco, Seattle, Los Angeles, Portland, Honolulu. Export Distributor: Bethlehem Steel Export Corporation, New York.

HARTFORD-EMPIRE COMPANY
HARTFORD, CONN.

Engineers and Licensors

FEEDERS FORMING MACHINES CONVEYORS
STACKERS LEHRS

Ceramic Kilns & Furnaces

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Our broad experience is at your service.

We represent the Ferro Enamel Corporation, Cleveland, Ohio, as sales agents for its complete and successful line of ceramic glazes.

ALLIED ENGINEERING COMPANY
4150 E. 56th STREET CLEVELAND, OHIO
(A SUBSIDIARY OF FERRO ENAMEL CORPORATION, CLEVELAND, O.)

Ceramic Service? We Give It

We Manufacture—

Pins
Stilts
Thimbles
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Saggers
Crucibles
Tile for Decorating Kilns

We Sell—

Ball Clay
Sagger Clay
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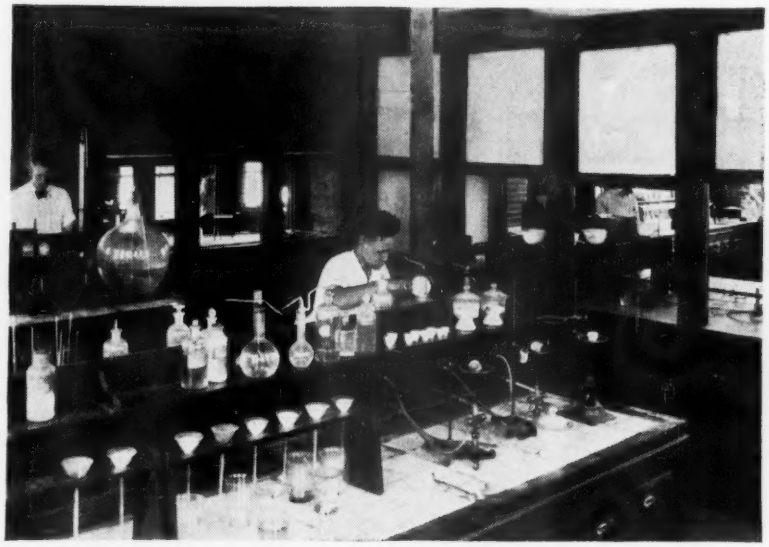
Ground Fire Clay
Bitstone
Fire Brick
Imported Paris White
Domestic Whiting

THE POTTERS SUPPLY COMPANY
EAST LIVERPOOL, OHIO



ANALYSIS . .

The Basis of Chemical Control in Producing

MINPRO *and* OXFORD "Chemi-Trold" Feldspars

GUARANTEED CHEMI-TROLD FELDSPAR

Raw materials must be just right to keep your ceramic processes operating smoothly and efficiently.

Rigid analytical supervision plays an important part in producing "Chemi-Trold" Feldspars to meet your needs. The patented (U. S. Patent 1,855,115) process of chemical control used to produce those spars—controlled production, controlled analyses, controlled purification—assures you of getting a uniform product, of specified quality, at all times.

"Chemi-Trold" Feldspars are furnished in accordance with the commercial standards C. S. 23-30, issued by the Bureau of Standards of the U. S. Department of Commerce, in these grades:

Minpro "Chemi-Trold" Granular Glasspar

Minpro "Chemi-Trold" Semi-Granular Glasspar

Minpro and Oxford "Chemi-Trold" Ordinary 20-Mesh Grinding

Minpro and Oxford "Chemi-Trold" Feldspars for Pottery and Enamel

Minpro "Chemi-Trold" Glaze Spar

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MORE IMPORTANT THAN ANY MATERIAL THING

MORE important than millions of telephones and millions of miles of wire is the fundamental policy of the Bell System. It is founded on a spirit of fair dealing with the public, with employees and with those who have invested their money in the business.

• • •

"The fact that the responsibility for such a large part of the entire telephone service of the country rests solely upon this Company and its Associated Companies also imposes on the management an unusual obligation to the public to see to it that the service shall at all times be adequate, dependable and satisfactory to the user. Obviously, the only sound policy that will meet these obligations is to continue to furnish the best possible telephone service at the lowest cost consistent with financial safety. This policy is bound to succeed in the long run and there is no justification for acting otherwise than for the long run. . . .

"Earnings must be sufficient to assure the best possible telephone service at all times and to assure the continued financial integrity of the business. Earnings that are less than adequate must result in telephone service that is something less than the best possible. . . . The margin of safety in earnings is only a small percentage of the rate charged for service, but that we may carry out our ideals and aims it is essential that this margin be kept adequate. . . . This is fundamental in the policy of the management."

Quoted paragraphs are from an address by Walter S. Gifford, president of the American Telephone and Telegraph Company, at Dallas, October 20, 1927.

BELL TELEPHONE SYSTEM

H. C. SPINKS CLAY COMPANY

Miners and Shippers of

BALL, SAGGAR AND WAD CLAY

NEWPORT, KY.

Gleason, Tennessee
October 10, 1934

Mr. R. B. Carothers, Gen. Mgr.
H. C. Spinks Clay Company
Newport, Kentucky

Dear Dick:

We have 10,000 tons of clay in our storage sheds. Each of the sheds will hold some more clay, and we will continue mining until bad weather stops us.

With this 10,000 tons of clay in the sheds, our customers are sure of getting prompt shipments of uniform shed dried clay during the winter months.

This is such a fine asset that I think you ought to tell the trade about it.

Sincerely yours,

Clayton

Sup't. of Mines

M and T

Sodium Antimonate

No matter where you look, you'll find no finer Sodium Antimonate than M & T. Its purity, fineness of grain and light fluffy texture set the standard for quality opacifiers.

Made of selected raw materials and scientifically processed with infinite care, every lot of M & T Sodium Antimonate is put through eleven exacting physical, chemical and enameling tests before it is shipped from the factory. You can depend on its uniform high quality to give you satisfactory results consistently.

M & T technicians have been solving enamelers' problems for more than twelve years. When trouble crops up, get in touch with M & T.

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CERAMIC DEPARTMENT

Homer F. Staley . . . . . Manager
R. R. Danielson . . . Director of Research